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No. 1,409] FRIDAY, NOVEMBER 21, 1879. [Vol. XXVIII.

ONE HUNDRED AND TWENTY-SIXTH SESSION, 1879-80.

Council.

H.R.H. THE PRINCE OF WALES, K.G., *President of the Society.*

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H. Trueman Wood, B.A.

Assistant-Secretary.
Henry B. Wheatley.

Accountant.
Howard H. Room.

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Arrangements for the Session.

The First Meeting of the One-Hundred-and-Twenty-Sixth Session of the Society was held on the 19th inst., when the Opening Address was delivered by Lord Alfred S. Churchill, Chairman of the Council. Previous to Christmas there will be Four Ordinary Meetings, in addition to the Opening Meeting, and the Papers will be read by General Scott, Prof. Silvanus Thompson, Mr. W. Simpson, and Captain Bedford Pim, R.N.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock. For meetings previous to Christmas:—

November 19.—Opening Meeting of the Session. Address by Lord Alfred S. Churchill, Chairman of the Council.

November 26.—"Suggestions for Dealing with the Sewage of London." By Major-General H. Y. D. Scott, C.B., F.R.S.

December 3.—"Apprenticeship: Scientific and Unscientific." By Silvanus P. Thompson, B.A., D.Sc., Professor of Experimental Physics at University College, Bristol. Professor Huxley, F.R.S., will preside.

December 10.—"Art Vestiges in Afghanistan; the Results of Some Recent Explorations in the Jellalabad Valley." By William Simpson.

December 17.—"The Panama Canal." By Captain Bedford Pim, R.N., M.P.

For meetings after Christmas :—

"Domestic Poisons." By HENRY CARR.
"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.
"The Utilisation of Slag." By CHARLES WOOD.
"Art in Japan." By C. PFOUNDES.
"The Trade and Commerce of the Yenisei." By HENRY SEEBOHM.
"Modern Autographic Printing Processes." By THOMAS BOLAS, F.C.S.
"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.
"Art Ironwork." By J. W. SINGER.
"The History of Musical Pitch." By A. J. ELLIS, F.R.S.
"The Recent History of Explosive Agents." By F. A. ABEL, C.B., F.R.S.
"Iceland and its Resources." By C. G. W. LOCK.
"The Future of Epping Forest." By WILLIAM PAUL, F.L.S.

Foreign and Colonial Section.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

February 3, 24; March 16; April 6, 27; May 18.

Chemical Section.

The meetings of this Section will take place on the following Thursday Evenings, at Eight o'clock :—

January 22; February 12; March 11; April 8, 22; May 13.

Indian Section.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock :—

January 30; February 20; March 5; April 2, 16; May 7.

Juvenile Lectures.

A Course of two Lectures will be delivered by MR. W. H. PREECE, on "Wonders of Sound" and "Wonders of Light," on Fridays, January 2, 9.

Cantor Lectures.

The First Course of Cantor Lectures will be by Dr. CHARLES GRAHAM, F.C.S., F.I.C., Professor of Chemical Technology at University College, London, on "The Chemistry of Bread and Bread-making."

November 24; December 1, 8, 15, 22.

The Second Course will be on the "Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S.

February 2, 9, 16, 23; March 1, 8.

The Third Course will be by R. W. EDIS, F.S.A., on "Art Decoration and Furniture."

April 5, 12, 19, 26; May 3, 10.

SYLLABUS OF THE FIRST COURSE.

LECTURE I.—NOVEMBER 24.

Introduction. Chemical composition of the chief bread-stuffs. The chief properties of starch, dextrin, starch sugars.

LECTURE II.—DECEMBER 1.

Continuation of the examination of starch and its hydration products. The albuminous matter of flour, soluble and insoluble.

LECTURE III.—DECEMBER 8.

Action of albumenoids. Rationale of kiln drying. Flour-making. The dough. Action of moisture, heat, and albumenoids on starch.

LECTURE IV.—DECEMBER 15.

Fermentation. Leaven. Yeast. Ferments of disease. Changes produced. The use of the microscope in the examination of yeast.

LECTURE V.—DECEMBER 22.

Baking; changes produced by heat. Aërated breads; foreign breads; biscuits, &c. Digestion of bread a continuance of fermentation; conditions requisite. Conclusion.

Proceedings of the Society.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade,

and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November and ends in June. The number of Meetings held during the Session amounts to between 70 and 80.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

FOREIGN AND COLONIAL SECTION.—This Section was formed in 187[illegible], under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It has now been enlarged, so as to include the consideration of subjects connected with our Foreign and Colonial Possessions generally. Six or more Meetings are held during the Session.

CHEMICAL SECTION.—This Section was formed in 1874, for the discussion of subjects connected with Practical Chemistry and its application to the Arts and Manufactures. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are Three Courses every Session, and each course consists generally of from Four to Six Lectures.

ADDITIONAL LECTURES.—Special courses of Lectures are occasionally given.

JUVENILE LECTURES.—A short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets will be issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—The Society's Examinations now comprise the following divisions:—1. Commercial Knowledge. 2. Domestic Economy. 3. Fine Arts applied to Industry. 4. Music. 5. Elementary. The Programme for 1880 is ready, and can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which the Members are invited, each Member receiving a card for himself and a Lady.

HEALTH AND SEWAGE OF TOWNS.—A Conference is held annually.

Membership.

The Society numbers at present nearly four thousand Members. The Annual Subscription is Two Guineas, or a Life Subscription of Twenty Guineas may be paid.

Every Member whose subscription is not in arrear is entitled:—

To be present at all Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admissions to all exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the Weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day immediately preceding election; or a sum of Twenty Guineas in lieu of all further contributions, may be paid.

All subscriptions should be paid to the Secretary, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-street, Adelphi, London, W.C.

Persons desiring to become members should communicate with the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

Calendar for the Session.

The following is the Calendar for the Session 1879-80. It is issued subject to any necessary alterations:—

NOVEMBER, 1879.			DECEMBER, 1879.			JANUARY, 1880.			FEBRUARY, 1880.		
1	S		1	M	Cantor Lecture I. 2	1	TH		1	S	
2	S		2	TU		2	F	Juvenile Lecture	2	M	Cantor Lecture II. 1
3	M		3	W	Ordinary Meeting	3	S		3	TU	For. & Col. Meet.
4	TU		4	TH		4	S		4	W	Ordinary Meeting
5	W		5	F		5	M		5	TH	
6	TH		6	S		6	TU		6	F	
7	F		7	S		7	W		7	S	
8	S		8	M	Cantor Lecture I. 3	8	TH		8	S	
9	S		9	TU		9	F	Juvenile Lecture	9	M	Cantor Lecture II. 2
10	M		10	W	Ordinary Meeting	10	S		10	TU	
11	TU		11	TH		11	S		11	W	Ordinary Meeting
12	W		12	F		12	M		12	TH	Chemical Meeting
13	TH		13	S		13	TU		13	F	
14	F		14	S		14	W	Ordinary Meeting	14	S	
15	S		15	M	Cantor Lecture I. 4	15	TH		15	S	
16	S		16	TU		16	F		16	M	Cantor Lecture II. 3
17	M		17	W	Ordinary Meeting	17	S		17	TU	
18	TU		18	TH		18	S		18	W	Ordinary Meeting
19	W	Ordinary Meeting.	19	F		19	M		19	TH	
20	TH	(Opening Meeting	20	S		20	TU		20	F	Indian Meeting
21	F	of the Session)	21	S		21	W	Ordinary Meeting	21	S	
22	S		22	M	Cantor Lecture I. 5	22	TH	Chemical Meeting	22	S	
23	S		23	TU		23	F		23	M	Cantor Lecture II. 4
24	M	Cantor Lecture I. 1	24	W		24	S		24	TU	For. & Col. Meet.
25	TU		25	TH	CHRISTMAS DAY	25	S		25	W	Ordinary Meeting
26	W	Ordinary Meeting	26	F	Bank Holiday	26	M		26	TH	
27	TH		27	S		27	TU		27	F	
28	F		28	S		28	W	Ordinary Meeting	28	S	
29	S		29	M		29	TH		29	S	
30	S		30	TU		30	F	Indian Meeting			
			31	W		31	S				

MARCH, 1880.			APRIL, 1880.			MAY, 1880.			JUNE, 1880.		
1	M	Cantor Lecture II. 5	1	TH		1	S		1	TU	
2	TU		2	F	Indian Meeting	2	S		2	W	
3	W	Ordinary Meeting	3	S		3	M	Cantor Lecture III. 5	3	TH	
4	TH		4	S		4	TU		4	F	
5	F	Indian Meeting	5	M	Cantor Lecture III. 1	5	W	Ordinary Meeting	5	S	
6	S		6	TU	For. & Col. Meet.	6	TH		6	S	
7	S		7	W	Ordinary Meeting	7	F	Indian Meeting	7	M	
8	M	Cantor Lecture II. 6	8	TH	Chemical Meeting	8	S		8	TU	
9	TU		9	F		9	S		9	W	
10	W	Ordinary Meeting	10	S		10	M	Cantor Lecture III. 6	10	TH	
11	TH	Chemical Meeting	11	S		11	TU		11	F	
12	F		12	M	Cantor Lecture III. 2	12	W	Ordinary Meeting	12	S	
13	S		13	TU		13	TH	Chemical Meeting	13	S	
14	S		14	W	Ordinary Meeting	14	F		14	M	
15	M		15	TH		15	S		15	TU	
16	TU	For. & Col. Meet.	16	F	Indian Meeting	16	S		16	W	Conversazione at
17	W	Ordinary Meeting	17	S		17	M		17	TH	South Kensington
18	TH		18	S		18	TU	For. & Col. Meet.	18	F	Museum
19	F		19	M	Cantor Lecture III. 3	19	W	Ordinary Meeting	19	S	
20	S		20	TU		20	TH		20	S	
21	S		21	W	Ordinary Meeting	21	F		21	M	
22	M		22	TH	Chemical Meeting	22	S		22	TU	
23	TU		23	F		23	S		23	W	Annual General Meet-
24	W		24	S		24	M		24	TH	ing
25	TH		25	S		25	TU		25	F	
26	F	GOOD FRIDAY.	26	M	Cantor Lecture III. 4	26	W	Ordinary Meeting	26	S	
27	S		27	TU	For. & Col. Meet.	27	TH		27	S	
28	S	EASTER SUNDAY	28	W	Ordinary Meeting	28	F		28	M	
29	M	Bank Holiday	29	TH		29	S		29	TU	
30	TU		30	F		30	S		30	W	
31	W					31	M				

The chair will be taken at eight o'clock at each of the above meetings, except the Annual General Meeting.

The Annual General Meeting will be held at four o'clock.

NOTICES.

JUVENILE LECTURES.

It has been found necessary to change the dates previously announced for the Juvenile Lectures from Tuesdays, December 30, and January 6, to Fridays, January 2 and 9.

NATIONAL CULTIVATION OF MUSIC.

The First Report on establishing Local Schools of Music, and Teaching Music by Notes in Public Elementary Schools, is now published, and may be obtained from the Society by transmitting one shilling in postage stamps to the Secretary, John-street, Adelphi, London, W.C.

NATIONAL TRAINING SCHOOL FOR MUSIC.

In consequence of the numerous applications from the public for admission, the Committee of Management of the National Training School for Music have made arrangements to receive private pupils for periods of not less than one year, on the payment of fees. Such pupils will be required:—

1. To pass a test examination to the satisfaction of the principal of the Board of Professors.

2. To furnish the authorities of the school with certificates of birth and health, and with testimonials from persons of good repute as to moral character.

3. To pay, in advance, to the bankers of the school, Messrs. Coutts & Co., Strand, the sum of £40 per annum.

4. To sign an agreement to observe all the rules of the school, and to work out the curriculum of studies appointed by the authorities of the school.

Applications and inquiries should be addressed to the Registrar, National Training School for Music, Kensington-gore, S.W.

PARIS EXHIBITION.—ARTISAN REPORTS.

The selected Reports on the Paris Exhibition, made by the artisans who were sent out last year by the Society of Arts, have now been published by Messrs. Sampson Low and Co.

The price of the volume is 7s. 6d. Members of the Society of Arts, and Exhibitors at the Paris Exhibition, can obtain copies from Messrs. Low and Co. for 5s. 8d. each.

Besides being published in a single volume, the reports have been issued in 11 divisions, making 12 parts in all, viz.:—

1. { Pottery and Glass. Part I. (4 reports.)
   { Pottery and Glass. Part II. (2 reports.)
2. Art Workmanship. (5 reports.)
3. Mechanical Engineering (4 reports.)
4. Agriculture and Horticulture. (3 reports.)
5. Building Trades. (5 reports.)
6. Cabinet Work. (3 reports.)
7. Watch and Clock-making, Jewellery, and Optical Instruments. (4 reports.)
8. Printing. (2 reports.)
9. Textile Fabrics. (2 reports.)
10. Leather and India-rubber. (3 reports.)
11. Mining and Metallurgy. (2 reports.)

In the hope that these parts may prove acceptable and serviceable to the classes interested in each particular industry, they have been issued at the price of 6d. each. Twelve copies of any of the parts will be supplied at 4s. 6d.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 19th, 1879; Lord ALFRED S. CHURCHILL, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Addis, William Judson, C.E., Prome, British Burmah.
Baillie, Captain Alexander, 19, Victoria-street, Westminster, S.W.
Boucherville, Boucher de, Quebec.
Bradshaw, James, 100, King-street, Manchester.
Braithwaite, Stephen Nelson, 25, Throgmorton-street, E.C.
Britten, Lieut.-Colonel John, 24, Ledbury-road, Bayswater, W.
Cavanagh, General, Long Ditton, Surrey.
Coiffier, Louis Alexandre Claris, 13, Hatton-garden, E.C.
Coop, Timothy, Bethany, Southport.
Covert, John Russell, 89, Chancery-lane, W.C.
Croger, Thomas Rodolphus, 37, Wood-street, E.C., and Lindon-villa, Ashby-road, Canonbury, N.
De Renzy, Deputy-Surgeon-General A.C.E., Shillong, India.
Deverell, W. T., 6, Blenheim-road, St. John's-wood, N.W.
Ditcham, William Vooght, D.D.S., 3, Belle Vue-place, Upper Clapton, E.
Duncan, Major Francis, R.A., M.A., LL.D., 29, The Common, Woolwich, S.E.
Eames, Mark, 40, Sclater-street, Shoreditch, E.
Edwards, Robert W., Sutton, Surrey.
Farnan, Henry, 155, Amhurst-road, E.
Fowler, George Cupit, 18, Finsbury-street, E.C
Gill, John Beadnell, M.D., Camden-lodge, Baldslow-road, Hastings.
Goldsmid, Major-General Sir Frederick John, C.B., K.C.S.I., 3, Observatory-avenue, Campden-hill, Kensington, W.
Greig, Andrew, C.E., Dundee.
Gwynne, Francis A., 15, Bury-street, St. James's, S.W.
Hassall, Harry Buckley, Currier Slack's, Ashton-under-Lyne.
Haviland, Alfred, M.R.C.S., Northampton.

Heldmann, Joseph, Brunswick-house, Shepherd's-bush, W.
Hollewell, Herbert, Bridge-street, Gainsborough.
Holmes, John, Laboratory, Somerset-house, W.C.
Howard, David, F.C.S., F.I.C., Rectory-manor, Walthamstow, E.
Hunt, John A., 2, Upper Chamberlayne-place, Southampton.
Huson, Thomas, 5, York-buildings, Dale-street, Liverpool.
Ibbotson, Alfred Buckingham, Villa Ibbotson, Fuori di Porta Romana, Florence.
Jones, J., 117, Newgate-street, E.C.
Jones, Robert Hesketh, J.P., The Briars, Crystal Palace-park, Sydenham, S.E.
King, William F., 9, Bessboro'-gardens, Pimlico, S.W.
Lark, Charles George Warnford, 89, Mostyn-road, Brixton, S.W.
Mason, Francis William, 79½, Gracechurch-street, E.C.
Mc Ginnis, Rev. D., Old Parsonage, Stourbridge.
Massey, Henry, 41, Park-street, Grosvenor-square, W.
Milligan, Joseph, F.L.S., F.G.S., 6, Craven-street, Strand, W.C.
Mitchell, Rev. George S., Granby-road, Manchester.
Moffat, Robert John, F.R.G.S., F.S.S., The Chestnuts, Great Shelford, near Cambridge.
Morrison, John, 87, West Regent-street, Glasgow.
Muir, Hugh, 30, Lombard-street, E.C.
Nathan, Hon. Henry, 110, Portsdown-road, Maida-vale, W.
Nesbett, George, Bournemouth.
Ommanney, Captain Montague F., R.E., 1, Downing-street, S.W.
Orr, John B., Ellerslea, Eltham, Kent.
Parkin, William, 15, Westbourne-road, Sheffield.
Parnell, George William, High-street, Chelmsford, Essex.
Perrins, James Dyson, Davenham Bank, Great Malvern.
Perry, H. R., Vernon-house, Spring-grove, Isleworth.
Pilcher, Paul, 9, Mount-villas, Lower Norwood, S.E.
Phillips, Sydney N., Newbridge.
Powell, John, 2, Huskisson-street, Liverpool.
Ramage, John, 31, Cranfield-road, Brockley, S.E.
Rowbury, Henry Edward, 37, Bentley-road, Prince's-park, Liverpool.
Robinson, Sir William Rose, K.C.S.I., Athenæum Club, Pall-mall, S.W.
Sanderson, T. H., 65, Wimpole-street, W.
Simpson, W. Spens, 49, Battersea-park-road, S.W.
Tapling, Thomas, jun., 31, Gresham-street, E.C.
Thomas, William Henry, 97, Cheapside, E.C., and 5, Vulcan-road, New-cross, S.E.
Walrond, Theodore, C.B., Springfield, Taplow.
Watts, Edward, 57A, Hatton-garden, E.C.

The Chairman delivered the following—

ADDRESS.

The task which the Society's bye-laws impose upon the Chairman of the Council at the commencement of each Session, recurring, as it does, year after year, is by no means an easy one. It is difficult, as each successive November comes round, for the Chairman to find a sufficient number of new topics of interest to lay before the members. The rule, however, is so far elastic that it merely provides that the Chairman of Council shall deliver an address to the Society at the first ordinary meeting after his election, leaving him perfectly free to choose the style and topic of his address. But, I take it, that the real object of the rule is to ensure that the members shall have laid before them the line of action which the Council propose to take during the ensuing Session. The Report of the Council, issued at the close of each Session, deals with the past; the Chairman's Address ought to deal with the future; and, inasmuch as history is always more easy than prophesy, so is it easier to render a simple account to the members of what has been done, than to lay before them a sketch of what it is proposed to do.

The objects of the Society are generally known to all of you, and need no explanation from me. I need only remark that of recent years it has always seemed the wisest course to make those objects as large and inclusive as possible. When the Society was founded, nearly a century and a-half ago, it was with the object chiefly of encouraging meritorious inventions by rewards, and of directing the attention of inventors to the needs of industry and commerce, in the hope that some ingenious person might come forward to supply the want as soon as a want had been made known. It was soon found that there was abundant room for a thoroughly practical Society on a somewhat wider basis than this. The Royal Society, though still holding, as it always has held, and I hope always may hold, the foremost rank among scientific bodies in the world, had fallen into a somewhat somnolent condition. I need not add that it has long since shaken off any weakness of this kind, but I think it is hardly doubtful that at the time I refer to it was not free from such a reproach. The days of "præ-scientific science" were over and done, the days of our modern science were but just beginning. Without ever rivalling the Royal Society, or conflicting with it in the slightest degree, the Society of Arts, I think, supplied the practical element which, at that time, was wanting at the Royal Society, and consequently it soon became more popular than the older body. It was frequented by the bearers of some of the greatest names in literature, science, and art. You may remember that Dr. Johnson was a not infrequent visitor; Goldsmith appears to have been a regular attendant at the meetings, and, at one time, canvassed for the office of secretary, although he does not appear to have proceeded very far in his efforts. At this time the labours of the Society were directed mainly towards the extension of commerce with the Colonies; the improvement of agriculture; the development of mechanical inventions; and the cultivation of the fine arts; though, in what I may call the first period of the Society's life, this last named department seems to have received less attention than it afterwards attracted. In the second period, from the beginning of the century, the department of fine art extended itself, and seems to have taken the first place. From being one of the smaller departments of the work, it developed to the most important. Not, indeed, that the fine arts had ever been neglected. Amongst the prizes offered at the formation of the Society were some for drawings by students. The first prize was taken by Richard Cosway, afterwards the fashionable miniature painter, whose genius or eccentricities gained the friendship and patronage of the Prince of Wales, afterwards George the Fourth; the second was won by Smart, also a miniature painter of repute in after years. Cosway was but the first of a long list of artists whose early efforts were aided by the Society,

while their maturer works have added lustre to its name. Amongst them are Nollekens and Flaxman, two of the greatest names in the short list of English sculptors, J. M. W. Turner, Edwin Landseer, Mulready, and our great popular living master, the foremost of his time, John Millais. At the early part of the present century there was hardly any young artist of promise who did not compete for a Society of Arts Medal; but as the Royal Academy grew and prospered, this portion of the Society's work naturally fell into its hands, and the Society of Arts again turned to the more practical and scientific portions of its labours.

But the time for such action as had been promoted by the founders of the Society had passed away, and there came a period of depression, during which the Transactions became less and less valuable, till at last they ceased to be published. The time of evil days did not, however, last for long. By the exertions of an earnest and active-minded body of men, a charter was obtained (1847), and the Society began a new era of its life, under the direction of the wise Prince to whose influence our arts and our industries owe so much. The results of renewed activity were soon seen in the Exhibition of 1851, which, as is well known, was but the development of a series of minor exhibitions held in these rooms. The work of the Society since then it is not now my object to recapitulate. Suffice it to say that its ruling body has always held it might legitimately take up any subject dealing with the industries or the welfare of the people, provided that such subject was not adequately treated by other means. It has been our constant practice, as special societies have grown up, to relinquish work which we had previously carried on, and to find for ourselves fresh fields of labour, and this is, I think, the reason of the great hold which the Society of Arts has upon the public.

Ready, however, as we are to act as the pioneers only in many fields of labour, we have yet one special field of our own—one which I trust we shall never relinquish to any other association or body of any kind, and this lies in the applications of science, and the applications of art, to practical purposes. It is a little too much the fashion nowadays to talk about the dignity of science, and the necessity of following science, not for its results, but for itself. For my own part, I have little sympathy with this feeling. It is for what science has done for humanity that we value science, and knowledge itself, apart from its results, would be, I fancy, but a barren possession. The real truth is, that, as we cannot foretell what the result of any scientific work may be, so it is our bounden duty to encourage such work in every direction; not looking for immediate results, but feeling sure that results will follow—it may be years, it may even be generations—after any genuine effort to increase man's knowledge of nature and nature's laws. With such an audience as I am addressing, there is no need to search for examples. Whether we think of Newton spending hours measuring the thickness of a soap-bubble film, or Oersted measuring the vibrations of a magnetic needle; or Rumford, boiling water by the heat produced by friction; or the discoverers of electro-metallurgy, taking copper-casts from medals, or any other apparently small beginnings of the greatest results of science, we see some wise man occupied in a trivial task, the pursuit of which was laughed at by his contemporaries, while its results were not known even to himself. I, therefore, am heartily at one with those who tell us that we must pursue science without looking for an immediate reward; but that is because I know that the reward will come sooner or later, not because I can admit that the acquisition of knowledge is sufficient reward in itself.

In days like these, when we are hardly familiar with one scientific marvel before we find its place taken by something yet more wonderful and more new, I cannot think that we shall ever want material for discussion at the Society of Arts. It is true that, for the last six months, we have had no new revelation of the mysteries of nature, and of man's power in measuring them, and some of us are beginning to grumble, because the telephone and phonograph are now stale and familiar, and we have nothing new to talk about, the electric light itself being now some two years old in its newest application; but yet, I think, we can hardly be said to have heard enough of such inventions as these, and I doubt not that those who are so greedy of fresh wonders will not be long before they have an opportunity of satisfying their appetites. So long as a new discovery remains the property of pure science it is not ours to meddle with in this Society; but as soon as some useful application is found for a discovery, it then becomes our duty to publish it abroad, to help, so far as may be, by suggestion and discussion, in improving it, to assist the discoverer to reap the due reward of his ingenuity.

I will say nothing of the hundreds of beneficial inventions which have been first brought into notice in this room, or have been fostered by the attention thus drawn to them, I will only remind you that, during the last few years, it was in this room that Professor Bell first introduced the telephone to a general London audience; that a few months later, when the phonograph had crossed the Atlantic, it had not been long in London before it came to the Society of Arts; that as soon as the question of general lighting by electricity began to occupy the public mind, the Members of the Society and their friends were afforded the opportunity of hearing all about the different systems employed, and of seeing illustrations of some of the principal, in this room. These are the more important of recent scientific discoveries with which we have been able to deal: and I can assure you that the activity, which the Council has endeavoured to show in bringing these forward, will not be wanting when any other like opportunity arises.

It is true that the work of discovery and advancing knowledge is a greater work than that of popularising it. I freely admit that the latter is second, but second only to the first. How, do you think, would science advance without public support and public interest? Time was when popular feeling and religion were allied against the advance of science. Science indeed, grew, even in those evil days, but it was with great difficulty. In our own more fortunate time, science has become the spoilt child of the people, and the result is seen in the enormous advances which have

been made during our own generation; consequently, I may say that the work of those who are content to popularise and make widely known the discoveries of others is by no means an unimportant work, and one to which this ancient Society need not be ashamed to devote its best efforts.

We are now in a period—or rather, let us hope, at the end of a period—of great depression in trade. And perhaps this is the proper time for us to attend to certain important considerations, about which, in time of our prosperity, we were too busy to think. We are subjected to the competition of other nations who are better educated than ourselves, and who have many, if not all, of the natural advantages which, for so long, we considered our own. We have rested too long content with our supremacy, and have neglected to make the efforts which have been forced upon other nations less fortunately situated than ourselves. Happily, I believe, our manufacturers are awakening to a sense of this truth. They have realised the fact that we must have a closer application of science to our industries, a more highly educated class of workmen, if they are not to be outstripped in the race. So long as England could keep ahead we might well be content to overlook many opportunities which other nations, anxious to overtake us, eagerly availed themselves of. But, now that our rivals are closing upon us, it behoves us to train and perfect ourselves as they have done, instead of relying on our natural untrained powers to win success in the great race. We must avail ourselves of every possible economy in our processes of production; every possible improvement in our methods of manufacture. Such economies and such improvements it is the duty of the Society of Arts to watch for, to try and bring forward, and to foster by every means in its power. This we have done in the past, and you may be sure we shall continue to do in the future; and, I trust, with no less success than we have been hitherto fortunate enough to enjoy.

But besides this constant duty of bringing forward and encouraging new discoveries and inventions in science and the arts, there are many special and occasional objects towards which the energies of the Society are devoted. I need not remind you that, since its foundation, the Society has never been content with the work it could carry on within these rooms. The first act of the committee which established the Society was to offer premiums for the growth of madder and the finding of cobalt in England. For long, the chief action of this sort consisted mainly in putting forth, at intervals, a premium list, offering rewards for various meritorious inventions and discoveries. The last list of this sort was published in 1873, but the results for some years previous to this had not been so satisfactory as to induce the Council to continue the offers. It might, indeed, possibly be worth trying the experiment once more; but, on the whole, it appears tolerably certain that the time for this line of work has passed by. Of late years, our plan has been to take up one subject after another, as opportunity served, and when the object sought had been attained, or when the matter had been proved to be of such importance as to deserve the attention and ensure the formation of a special organisation, to turn to fresh pursuits. In this fashion, we have treated, from time to time, such subjects as the supply of food, and especially that of fish, the law of patents and of art copyright, art workmanship in its various departments, the cheap production of scientific apparatus, the general and technical education of the people, and many other topics. Our greatest achievements have been in connection with the two great Exhibitions, to the first of which I have before referred.

You are aware that the chief matter with which we have been dealing during the last few years has been sanitary reform. We have held congresses—the word is not a very good one, but I know of no better—on the subject; and I am clearly of opinion that the great attention which has been drawn to this subject during the last few years has been almost entirely due to the efforts of the Society of Arts. Many of the houses which are springing up all round the outskirts of the metropolis are certainly deficient enough in sanitary respects; but they are by no means so deficient as those which were built, even so short a time as five years ago. The speculative builder has begun to find out that one of the most attractive points he can urge on behalf of his house is, that it is well supplied with the newest sanitary fittings. Drains are ventilated, proper appliances are supplied, in fact, I believe the houses which are being built today are twenty or thirty per cent. better, in this respect, than the houses which were being built half-a-dozen years ago. I do not wish to claim more credit than is our due, and it is impossible to say to what cause more than another movements of public opinion are owing; but it is my sincere conviction, as I said before, that nearly all the growth of this feeling is due to our work.

At the same time, we have endeavoured to promote musical education by the establishment of a school at South Kensington; we have done our share towards technical education by establishing and carrying on the Technological Examinations, which I hope to see flourish with increased vigour, under the auspices of that new and energetic body, the City Institute for Advancing Technical Education. We founded examinations in general subjects, and have carried them on until it has appeared that other bodies—special educational bodies—are doing nearly all the work we once did, and appear ready to undertake the remainder.

We are ready to take fresh action in any direction which may seem desirable; and I can assure you that the Council are constantly considering fresh methods of applying the Society's influence for the promotion of the public good. Some of the proposals made are not accepted, others, when taken up, appear less useful than they did at first, others, which seemed very promising at the outset, eventually prove impracticable or useless, others, again, are carried to a successful issue. At present the Council has several matters under consideration, some of which I hope may be successfully carried out before the close of the Session.

And now a few words as to the arrangements for the coming Session. You have already received a copy of the Programme, and it will also be printed in the same number of the *Journal* which contains this address. For our first meeting, on Wednesday next, we have secured a paper on the "Sewage of London," by Major-

General Scott, on whom, I think, we may rely to bring forward some novel views upon this most important question. The subject of technical education, which is year by year exacting more attention, will be dealt with in a paper on "Apprenticeship: Scientific and Unscientific," by Mr. Silvanus Thompson, the Professor of Experimental Physics at University College, Bristol, and on this occasion we shall have the further advantage of the presence of Professor Huxley in the chair. Mr. William Simpson, who was out in Afghanistan as the special correspondent of the *Illustrated London News*, has made some very interesting discoveries on the civilisation of the races who inhabited that country in very early periods, and these he will bring before the Society in his promised paper on "Art Vestiges in Afghanistan." The other paper before Christmas will be by Captain Bedford Pim, on "The Panama Canal." Captain Pim has already treated this subject in a very interesting paper read before the British Association, and he is well known to have special knowledge on this important subject—a subject well worthy of full discussion in the rooms of the Society.

We have also arranged for a number of papers which will be read during the latter part of the Session. These it would take too long to enumerate, but I may say that, amongst them, will be treated the subject of "The Utilisation of Slag," by Mr. Wood, of Middlesborough; "The History of Musical Pitch," by Mr. A. J. Ellis, who has already read papers on similar topics before us; several subjects dealing with the applications of art to industry, amongst them a paper on "The Art of Bookbinding," by our new Assistant-Secretary, Mr. H. B. Wheatley; and, finally, a paper on "The Recent History of Explosive Agents," by Professor Abel, provided the numerous engagements of the learned professor leave him sufficient leisure to fulfil his promise during the present Session.

As the Sectional Meetings do not begin until after Christmas, it has been thought well to defer till then any notice of the, as yet, incomplete arrangements for them. Our first series of Cantor Lectures is by the accomplished chemist who gave us such an admirable series of lectures on "Brewing." a few years ago, Dr. Charles Graham. His subject is "The Chemistry of Bread and Bread-making." The second course deals with a thoroughly practical subject, "The Manufacture of India-rubber and Gutta-percha." It will be by Mr. Bolas, who is already favourably known to you by his lectures on "The Application of Photography to the Production of Printing Surfaces." The third course deals with a portion of the Society's proper work, which has not, I think, received, of recent years, the amount of attention it ought to have received—I mean the subject of art industries. Mr. R. W. Edis, who is known both as a writer and as a practical architect, has undertaken a series on "Art Decoration and Furniture," which will be given in the latter part of the Session.

The subject of the Juvenile Lectures was not announced in the Programme which was issued to the Members. I am now glad to be able to say that Mr. W. H. Preece has undertaken to give a short course, on the recent advances in science, under the titles of "Wonders of Sound" and "Wonders of Light." Amongst our living lecturers Mr. Preece has few equals in clearness of exposition, in power of making difficult subjects clear to a popular audience; and I think our juvenile friends are to be congratulated on the opportunity they will have of listening to him.

With regard to some of the other portions of the Society's work, the prosecution of those many public objects with which it, from time to time, endeavours to deal, it is less easy to forecast the future. The question of repeating the annual Conference on Water Supply, and on Health, is now before the Council, and it is not yet decided what steps will be taken with regard to it. It is possible it may be considered desirable to omit it for a year, in the hope that more fresh material may be available for discussion after a longer interval. Should it be held, it is probable that the scope of the Conference may be enlarged, so that it may include all subjects bearing on National Health.

The Council propose to continue the work which they undertook some time since, in reference to the Universal Catalogue of Printed Books. It will be in the recollection of the Members that last year a report was presented to his Royal Highness, the President of the Society, recommending that the first step to be taken towards providing such universal catalogue would be the printing of the existing catalogue of the British Museum. Since that report was issued, the committee have taken steps to ascertain the approximate cost of such a work. The importance and necessity for some printed catalogue of the printed books in the British Museum has received the unanimous approval of the press and learned authorities. An influential meeting of librarians have discussed the general subject, and the expediency of arranging the catalogue in classes rather than alphabetically. But, above all, the public may be congratulated that the trustees of the British Museum have obtained the sanction of the Government to printing, from time to time, the titles of the printed books as they are added to the library, thus confirming the soundness of the general idea of the Council's report. This measure is to be carried out at once.

During the recess several communications have passed between the Secretary of the Society and the City Lands Committee on the subject of memorial tablets, and the Corporation have now expressed their readiness to undertake to erect memorial tablets in the City, if the Society of Arts will submit suitable names of persons to be thus distinguished, the Corporation, of course, reserving the right to accept such names or not, as they may think fit.

In the last report of the Council, it was stated that the publication of the Artisan Reports on the Paris Exhibition had been under the consideration of the committee, and that they had determined upon publishing a selection of them. This selection has now been issued, both in a single volume and in twelve parts. It was found necessary not only to make a selection of the reports, but to submit the selected reports to a certain amount of revision. Although great pains were taken not in any way to alter the opinions of the writers, or to modify the statements they had made, it was yet

found that considerable care had to be exercised, in order to eliminate crudities of style, and to put the reports in something like a readable form. The Council hope that this object has now been attained; and, looking at the complete volume, they have every reason to be satisfied with the result of the labours of the joint committee of members of their own body, and members of the Royal Commission. The collected reports make a stout book of nearly 700 pages, and, through the assistance of Messrs. Eyre and Spottiswoode, and of Messrs. Sampson Low and Co., this book has been published at the very moderate price of 7s. 6d. The separate parts have been issued at a cost of 6d. each, so that it is hoped that the artisans interested in the various industries may avail themselves of the opportunity of learning the opinions of men of their own class upon the wonderful exhibition which was held last year in Paris.

Such a book as this cannot fail to be of very great value to all who are interested in watching the progress of our industries. It is full of the carefully considered opinions of men whose opinions are of very great value, and of all the more value because the standpoint from which they regard questions is one which, so far as I know, has never been occupied by any writer or speaker on the subject. Looking through the separate reports, written by men who were in Paris at different times, and had but little opportunity of consultation with one another, there is a remarkable *consensus* of opinion upon many points. One of the most evident of these is a strong feeling of the superiority of English over foreign workmen. How far this feeling is to be attributed to national pride, and to natural habit, it is difficult to say, but the expression of it is supported, in many instances, by very sensible argument and very good logic. But our artisans, though almost unanimous as to the superiority of their fellow-countrymen as regards work, are almost equally unanimous as to many advantages which the foreigner possesses over us. Perhaps foremost amongst these may be mentioned the great quality of sobriety. Over and over again in the reports appears the comment upon the sober and temperate character of the French, as compared with the English, workman—his greater thrift, his greater capacity for simple, yet elevating, amusements; even, in many cases, his greater industry. I sincerely hope that the great fact, so often stated, that the heaviest curse of the English artisan is his tendency to inebriety, will be impressed upon members of that class, now it is so forcibly stated by so many of their fellows. It is, perhaps, natural that our writers should, almost all of them, agree as to the desirability of shorter hours of work, although it must be said to their credit that they do not join with that the common demand for higher rates of pay. They all of them argue that the Englishman, working a shorter number of hours per day, will produce better and more work than the Frenchman working the longer hours. And the question of long hours of work comes in not only as regards the amount of week-day occupation, but as regards the question of Sunday leisure. In many French trades it is the habit to treat Sunday almost as a working day, and in many more the men work for half the day, taking the other half for a holiday. To the English workman, fresh from his weekly holiday, this naturally appears a great sacrifice.

I hope that many of our members will get this interesting volume, and study it for themselves. Those of you who are connected with any industry will learn something by considering the way in which that industry is regarded by those to whom so much of its success is due. Those who are interested in the condition of our working classes will see how the conditions of life of artisans abroad strike those of our own country. Both to the labourer and to the employer of labour such a study cannot but be beneficial, and though there is naturally much in the book with which it is difficult to agree, not a little that is trivial, and even a few statements which it would not be hard to show are entirely erroneous, there is also much of value and much of interest in it. It is now just a year since the Great Paris Exhibition closed, and we are therefore in a position to look back upon it and consider its results. As regards the share in it of our own country, those results have been, I think, most satisfactory. We showed the world that we, who a few years ago were considered the most backward of European nations in all pertaining to art and good taste, were now amongst the foremost. We taught foreign critics that an English school of painting not only existed, but could vie with any other school, that in our application of art to industrial workmanship we could rival those Southern nations with whom the appreciation of form, and colour, and beauty, seems innate. With all this, too, we proved that this artistic excellence was not—as it has so often been—a sign of decadence. We were still superior in our iron and steel manufactures, in our engines and machines. True, our superiority was less marked; we were not so far ahead, but still we were in the front. And there is one point which is not less pleasant to reflect upon than all our commercial victories, and that is, that no small share of the success, not only of the British Section, but of the whole Exhibition, is due to the individual personal action of the President of our Royal Commission. To have strengthened the bonds of friendship between two great nations is a task worthy of our future monarch, and this task was successfully performed by the Prince of Wales. No Englishman visiting Paris in the summer of 1878 could fail to notice the specially cordial feeling shown by all classes towards this country, or could ignore the fact that the origin of this feeling was to be found in the conduct of the Prince of Wales in reference to the Exhibition. I know not how soon the proposal may be made to hold an Exhibition in London, nor do I know how such a proposition would be received; but I feel sure the Society of Arts will be ready again, if the opportunity arises, as it has been before, to take the preliminary steps needful for such an enterprise. To carry out the work of such an Exhibition, of course, a Royal Commission would be required, and it is certain that popular feeling would not be satisfied unless that Royal Commission was presided over by the Prince of Wales. Much, however, would have to be done before the appointment of such a Commission, and I am sure I express the

unanimous feeling of the Members of the Society of Arts, when I say that our Royal President would have the full support of the Society in the undertaking, whenever the time may come for its inception.

Among the matters now receiving the attention of the Council is the accommodation for the members at the meetings and in the Library. At the last general meeting of the Society, some suggestions were made as to the opening of the Library during the evening; a committee of the Council went carefully into the matter, and the result was a report, which was published in the *Journal*. In order to meet the wishes of members, the smaller reading-room will be opened in the evenings on which meetings of the Society are held. During the recess the condition of the Library has been made the subject of a careful examination, and some alterations, have been made in the arrangements of the books. The preparation of a new catalogue appears desirable, and this will be commenced at once. It is also evident that the room in which we now meet requires renovation. Nothing beyond ordinary cleaning has been done to it for a good many years, and a committee of the Council have now under consideration the requisite measures. At the same time the committee will endeavour to ascertain if it could be possible to provide increased accommodation for our meetings, the necessity for which has been strongly evidenced on several recent occasions. The members will understand that such improvements as these cannot be undertaken without careful consideration, and with our large expenditure on public objects it becomes necessary to see our way clearly to the necessary funds before undertaking them. These funds, however, the Council believe, will be provided by various economies, the results of which will be shown in the balance-sheet of the current year.

I have directed your attention to some of the matters which will occupy the attention of the Society during the present session. There are many others on which I might dilate, did time permit. There are others, again, which we cannot now foresee, but which will doubtless, as before, arise to give us work. And let me conclude by saying, even at the risk of repeating what I have often said before, that the success of all our undertakings rests on the hearty co-operation of the members and on that alone. Unless our members, alike those on the Council and those who are not, lend their energetic aid to the Society's work, that work cannot go successfully on. It is by the united efforts of public spirited men that our Society was founded, it is by such efforts that it has been brought to its present state of influence and prosperity. It must be by such efforts that it can be rendered, as it must and will be rendered, more influential and more prosperous. We want a yet largely increased list of members, and this increase can only be attained by a process of self-multiplication. If those of us who are interested in the Society's work—and it is but a reasonable idea that most of us are—would induce one or two friends to join our body, we should soon double our numbers. With increased numbers come increased influence, increased power for useful work; and there is plenty of work before us, if we have the means to apply to it.

Dr. Siemens, F.R.S., in proposing a vote of thanks to Lord Alfred S. Churchill for his able address, remarked on the large number of points of interest alluded to in it, and on the lucid statement of the objects of the Society which it contained.

Mr. W. Botly seconded the proposal, and said that each of the paragraphs of his Lordship's address might be amplified into a lecture. He was particularly pleased with the portion relating to the artisans' reports, and hoped that members would purchase copies for presentation to mechanics' institutions.

The vote was carried unanimously.

The Chairman then presented the following Medals and Prizes:—

The Gold Medal, offered for the best means of saving life at sea:—

To Messrs. J. and A. W. Birt, "for the collection of buoyant articles sent in by them."

The Society's Silver Medal:—

To Mr. Herbert Singer, "for his essay on the art of the silversmith."

To Mr. F. Toplis and to Mr. Joseph Lucas, "for their papers containing suggestions as to the best means of dividing England and Wales into districts for the supply of pure water."

To Mr. Alfred Haviland, M.R.C.S., for his paper on "The Distribution of Disease popularly considered."

To Mr. John Hollway, for his paper on "A New Application of a Process of rapid Oxidation, by which Sulphides are utilised as Fuel."

To Mr. Conrad W. Cooke, for his paper on "Edison's loud-speaking Telephone."

To Mr. Thomas Wardle, for his paper on "The Wild Silks of India, principally Tusser."

To Dr. William Wallace, F.R.S.E., for his paper on "Gas Illumination."

His Royal Highness the Prince Consort's Prize of Twenty-five Guineas, accompanied by a special certificate, to Frederick John Arnold, 24, of the Birkbeck Literary and Scientific Institution, in the Civil Service, who has obtained the following First Class Certificates in the Society's Examination, during the specified period:—

1876. English.
,, Book-keeping.
,, French, with the Second Prize.
1877. Political Economy, with a Prize of Books.
1878. Commercial Geography and History.
,, Knowledge of Contents of Public Museums, with the First Prize.
,, Clothing.
,, Cookery.
1879. Arithmetic.

The Council Prize (for female candidates) of Ten Guineas, accompanied by a special certificate to Ada Frances Webb, 16, of the Birkbeck Literary and Scientific Institution, and of the College for Working Women, Fitzroy-square, W., silk-knitter, who at the Society's late Examinations obtained the following First Class Certificates in the specified period:—

1878. Book-keeping, with the Prize for Females.
1879. Housekeeping and Thrift.
,, Cookery.

*** In addition to these, this Candidate has Second Class Certificates in Arithmetic and English.

MISCELLANEOUS.

THE ELECTRIC LIGHTING OF INTERIORS OF LARGE BUILDINGS.*

For the illumination of the interiors of large buildings, the choice of the particular form of light must depend very much upon the cubic space to be lighted up; though of course the form and use of the building must be taken largely into consideration. For instance, the Royal Albert Hall, with its 150 feet from the "velarium"-screen to the arena, naturally lends itself to the use of large lights, which have the power to transmit their illumination through this long distance; while again a room only 20 feet or so in height would be more suitable to the use of a "candle"-light, if not even to the more moderate-sized semi-incandescent light, such as the Werdermann light, which is being tried with apparent success in the small Art Library of the South Kensington Museum.

In the illumination of interiors, one chief point to be avoided would appear to be to have but one light-centre; as very marked and very objectionable shadows are the result. Whereas with several light-centres they are to a great extent avoided; and also to a certain degree any flickering from one luminary is somewhat neutralised by the rays from its neighbour. Not merely should any direct exposure of the bright luminous point to the eyes of the spectators be avoided, by suitable protection of glass or otherwise, but even direct projection or reflection of the luminous rays down on to the spectators should be dispensed with where practicable. Double reflection, on to and from the ceiling and adjacent walls, thereby more fully diffusing the light, distributing it and rendering it like to sunlight, while at the same time toning it down and neutralising in a great measure many of its irregularities, is, so far as the author's experience goes, by far the most agreeable mode of illuminating interiors with the electric light.

Into the consideration of the illumination of interiors there enters another question, apart altogether from the efficiency of the light, and that is, its effect upon the surrounding atmosphere from a sanitary point of view. In this respect its effect is twofold, viz., 1st, the amount of vitiation caused by noxious products and formed vapours during combustion; and, 2ndly, the quantity of heat given off to the surrounding air.

The unpleasant and unwholesome effects caused by gas illumination on both of these heads, particularly where the lights are naked, are so well known, that the possibility of the substituton of that illuminant in crowded rooms by the electric light has been welcomed with pleasure in many quarters; and the amelioration accepted as an accomplished fact. Some months ago, however, serious doubts were raised on one of the above points, that of noxious emanations, by a chemist of great promise, the late Mr. Thomas Wills; whose sudden and premature death at the outset of what promised to be a very brilliant and useful career is much to be deplored. He announced at the Chemical Society towards the close of last year, that, from experiments he had carried out, he had reason to suppose that nitrous oxides were given off in considerable quantity by the electric light from carbon electrodes, due to the high temperature of the electric arc. It is, however, credibly reported that, on further investigation, he found, before his death, the amount of the noxious emanations to be less than he had previously supposed. However, the fact still remained that gases of this nature were given off, and it was thought well to inquire somewhat into the matter.

It is with much pleasure that the author is enabled to lay before the Association the results of some experiments made by Mr. F. J. Evans, of the Gaslight and Coke Company, which he has kindly prepared specially for this occasion; the results of which have been analysed by Mr. McMinn, a chemist of much experience in the employ of the same company.

The experiments, at which the author was present by the invitation of Mr. Evans, were carried out in July of this year, at the premises in Horseferry-road, Westminster, of the Gaslight and Coke Company. An 8-horse power "Otto" gas engine actuates, by means of overhead shafting, a small-sized Siemens electric machine (1,200 candles nominal); the current of which is supplied to a small-sized Siemens lamp. The number of revolutions of the electric machine during the experiments was 1,000 per minute.

In the first experiment, the amount of nitrous acid was 1·481 grains, or 2·933 cubic inches; of carbonic acid, 98·1 grains, or 207·9 cubic inches. In the second experiment, the amount of nitrous acid was 5·057 grains, or 10·010 cubic inches; of carbonic acid, 178·2 grains, or 376·7 cubic inches.

The luminous arc and the adjacent portions of the carbons were placed in a closed copper-framed square box, six inches each way, with the sides of talc. In one of the sides of the box, near to the top, was placed the end of a tube, the other extremity of which was in communication with the air-pump of a horizontal engine, in an adjacent room, and used for pumping water and other purposes. Upon the exhaust-pipe, thus constructed to carry of the products of the electric light, were placed close to the light a series of four pint bottles, through all of which the products were compelled to pass. The first three bottles contained a solution of caustic potash, each bottle having about 100 grains of potash to half a pint of water; the fourth bottle consisted of "lime water." The carbons employed for the electric light were $\frac{1}{2}$ inch in diameter, and each hour's burning (the normal duration of each experiment) consumed about $2\frac{3}{4}$ inches—1 inch of the negative carbon, and $1\frac{3}{4}$ inches of the positive; or, by weight, 214 grains.

The result analytically of each of the two experiments is set forth by Mr. McMinn. There is a very considerable difference between them, both the nitrous acid and the carbonic acid being much more in the second experiment than in the first. Mr. Evans considers that this is partly due to the increased current of air through the apparatus in the second case. The experiments do not pretend to have been carried out in such a way as to give more than an approximate result. Indeed, Mr. Evans does not consider them in any way conclusive, and intends to repeat them.

The results are, however, sufficient to enable one roughly to estimate the comparative value of the noxious emanations from the electric light and from gas illumination. The deleterious gas in the former case being nitrous acid, and in the latter sulphurous acid, both of which being objectionable in somewhat about the same degree, it becomes a question rather of the relative quantities of each in the respective iluminations.

Taking the nitrous acid total in the second experiment, the larger of the two, 5 grains, the result of the production of a light of, say, 1,000 standard candles during one hour. In the combustion of gas, from 10 to 20 grains of sulphur per 100 cube feet of gas is, it is understood, a good result. Say 10 grains of sulphur, or 20 grains of sulphurous acid per 100 cube feet of gas; the illuminating value of which would be 400 standard candles per hour. Therefore, an illumination by gas of 1,000 candles per hour would require the consumption of 250 cube feet of gas; giving off 50 grains of sulphurous acid; as against the 5 grains of nitrous acid arising from the electric light.

Supposing, however that in actual illumination the

* From a paper on electric lighting read before the Association of Municipal and Sanitary Engineers and Surveyors, by James N. Shoolbred, B.A., Mem. Inst. C.E.

1,000-candle electric light was found only to replace 20 gas jets, of 3·5 cube feet each, and yielding a total light of 200 candles. This would give a total hourly consumption of 70 cube feet of gas yielding 14 grains of sulphurous acid.

The small amount of the carbonic acid emanating from the combustion of the electric light may be gathered from that stated in the second experiment; the larger amount of the two. The quantity is given as 377 cube inches, not quite ¼ cube foot, as the result of one hour's burning. When it is borne in mind that each person is supposed to give off about ½ cube foot per hour, or double the above emanation, an idea of its baneful character may be formed.

In the further continuation of the sanitary aspect resultant from illumination, next occurs the question of the amount of heat developed.

The evidence of a very distinguished electrician, Sir William Thomson, given before the Select Committee on Lighting by Electricity, gives some clue—at least, theoretically—to the relative amounts of heat given off by illumination by electricity and by gas. Sir William Thomson stated that the energy which is actually used in the electric arc is about 1 horse-power per 1,600 candle-power, and that with gas 1 horse-power produced only 12 candle-power. This would indicate an expenditure of 133 times more mechanical energy per candle-power with gas than with electricity; or, if converted into heat, that 213·7 heat units (Joule) would be developed during the hourly maintenance of 1 candle-light by gas, as against 1·6 heat units per candle by electricity. This would, taking each cube foot of gas per hour to be of 4 standard candle-power, cause each cube foot of gas to give off 854·8 heat units per hour.*

This calculation is nearly confirmed by the experiments made in connection with lighting and heating by gas in the City of Paris; viz., 1 cube metre of gas giving 8,008 calories.† This would cause the cube foot of gas to give off 898·8 heat units per hour. The mean of these two values would give 877 heat units per hour.

Taking the last-named figure as the result per horse-power, and comparing it with the electric light systems already referred to, viz., the Jablochkoff, the Gramme, and the Siemens—then on the assumption that the total horse-power absorbed by each of them is respectively 1, 2·5, and 3 horse-power, of which one-half is absorbed in the electric arc (though it actually must be less), the comparative amounts of heat given off by each, and that of a gas illumination which may be taken in practice as the equivalent of each, would stand thus:—

	Electric Illumination.			Gas Illumination.		Ratio of Heat Units. Gas to Electricity.
	Light in Standard candles.	H.P. in Arc.	Heat Units.	Jets of 3·5 c.f. each	Heat Units.	
Jablochkoff	400	0·5	1,282	10	30,625	24 to 1
Gramme ...	2,000	1·25	3,205	30	92,025	28 to 1
Siemens ...	4,000	1·5	3,846	40	122,780	32 to 1

Turning to the actual effect of the two illuminations, by gas and by electricity, when tried simultaneously, the effects experienced at the Art Library of the South Kensington Museum may be quoted. One large room, in all 54 feet by 54 feet, by about 18 feet high, is divided down the centre, so as to form practically two rooms. The gas illumination in each room is effected by means of 15 argand burners, arranged in threes, suspended from the ceiling, and brought down to about 10 feet from the ground. Three Werdermann lamps in each room, on standards about 9 feet high, are occasionally used in the evening in place of the gas. The effect on a summer's evening has been most marked, and the contrast rendered still more so by the two illuminations being used alternately on the same evening, the relief obtained by the use of the electric lighting from the increase in temperature caused by the gas being remarkable and speedily felt.

Nor is the great disproportion between the heat evolved by the electric arc and by the combustion of coal gas to be wondered at, when the composition of the latter is taken into consideration; notwithstanding even the very high temperature of the electric arc, Professor Bunsen,* in his analysis of Manchester cannel gas, found that while the illuminating components only represented 6·5 per cent. of its volume, the non-illuminating heat-producers formed 87 per cent. Besides, in the amount of heat evolved respectively this disproportion is still further considerably increased (chiefly owing to the heat-producing qualities of the hydrogen and of the marsh gas).

Then again there must be borne in mind the very small amount of the surrounding air, which can have access to the small and single electric arc, as against the very much larger area of flame presented by each of the many gas jets. The disproportion between the heating surfaces in the cases of illumination just mentioned would probably amount to 200 times.

SCIENCE IN SCHOOLS.

The following correspondence has been forwarded for publication by Mr. T. Twining, who is prepared to carry out his proposal at the first favourable opportunity, probably after the Christmas holidays:—

Memorandum concerning assistance offered to the School Board for London by T. Twining, in providing competent Teachers for the proposed Scientific Object Lessons.

In order to derive full value from the measures adopted by the School Board for London, at the suggestion of Dr. John Hall Gladstone, F.R.S., for introducing the elements of the science of common things in the lower standards of primary schools, and also in order that this early initiation may be followed up by a progressive development, leading ultimately to the "Special Subjects" of the Code, it is obvious that such initiation and development should be entrusted to teachers thoroughly qualified for the discharge of their important duties. They should not only have, as it were, at their fingers' ends, the knowledge they are called upon to diffuse, but be specially trained in the peculiar art of explaining, in a pleasing manner, with a limited supply of cheap apparatus, the applications of elementary science to the familiar requirements of daily life, and able to turn to account with ingenuity and originality every available resource, thus producing a a maximum of results with a minimum of outlay.

The elementary notions of physics, chemistry, natural history, and physiology, embraced by my "Science made Easy" course having been selected and developed with a special view to purposes like these, it may be hoped that the School Board will favourably consider my offer to place that course at the free disposal of its junior teachers of both sexes in a series of twenty class lessons, specially adapted to pedagogic requirements, to be held at the Middle-class Schools, Cowper-street, City-road. A full collec-

* With the heat unit of 772 foot-pounds (Joule), and the horse-power at 32,300 foot-pounds per minute, or 1,980,009 per hour, the thermal equivalent of one horse-power per hour is 2,564 heat units.

† See "Formulaire de l'Ingénieur-constructeur," par Ch. Armengand jeune, 1865.

* "Gasometry." by R. Bunsen, translated by H, E. Roscoe, 1857.

tion of the required apparatus and diagrams is permanently located there for the regular instruction of the boys by Mr. John A. Bower, the science master, and that gentleman, whose abilities and experience are well known, would take charge of the proposed pedagogic course. Not only would no expense be incurred by the Board or the teachers, but a suitable prize fund would be provided in connection with the examinations at the close of the course.

School Board for London,
Victoria Embankment, W.C.
10th November, 1879.

Sir,—Your memorandum offering assistance to the School Board for London in providing competent teachers for the proposed scientific object lessons, has been carefully considered by the School Management Committee.

I am directed, in reply, to state that they are very glad to hear that such lectures are going to be delivered, and they will be pleased to facilitate the attendance of the teachers.—I am, Sir, your obedient servant,

G. H. Croad, Clerk of the Board.

T. Twining, Esq., Twickenham.

MINERAL STATISTICS OF VICTORIA.

From the report of the mineral statistics of Victoria for 1878, just issued, we take the following *data* :—The returns show that 874,717 tons 6 cwt. of quartz have been obtained from the mines during the past year as compared with 956,573 tons 15 cwt. raised in 1877. According to the estimates made by the mining registrars, the quantity of gold raised in Victoria in 1878 was 758,941 oz., being 51,613 oz. less than the quantity raised during 1877. Of this quantity 264,453 oz. were alluvial and 493,587 oz. from quartz. It may be observed that, while the annual decrease since the year 1868 in the amount of gold obtained from alluvial deposits still continues, the amount of decrease during 1878 is not so large by 42,846 oz. as that during the year 1877. The annual reduction of the yield of gold from alluvial workings is owing to the gradual and inevitable exhaustion of the auriferous drifts of the earlier discovered goldfields, and to the fact that in later years no new areas have been discovered of sufficient extent and richness to compensate for the diminished yields obtained from the older alluvial workings. Contrary to expectation, the yield of gold from quartz mines is 26,312 oz. less for the past year as compared with the amount obtained in the preceding year, but this decrease is very much less than for the year 1877 as compared with the return for 1876, which was 85,960 oz. The pyrites, blanketings, &c., operated on during the past year have proved to be more auriferous than those treated in the year 1877; and thus, although the quantity manipulated is less by 1,984 tons as compared with the return for 1877, the amount of gold obtained during 1878 is almost equal to that derived from the same class of products in the previous year, and, of course, the average yield per ton is correspondingly increased. The yield per ton was 2 oz. 10 dwt. 13 gr. in 1878 as compared with 1 oz. 16 dwt. 21 gr. in 1878. During the ten years, 1869-78, a total yield of 133,890 oz. 16 dwt. 17 gr. of gold was obtained, equal to an average of 2 oz. 10 dwt. 18·66 gr. per ton. Some figures given in the report respecting pyrites works in the colony bear significant evidence of the growing interest taken in auriferous pyrites by parties engaged in the extraction of gold from these products. The number of works as compared with the return for the previous year has increased by eight, the number of men employed by 235, and the estimated value of the requisite machinery by upwards of £24,000. The quantities of vein-quartz crushed and the average yield per ton of gold obtained therefrom were during the past year, according to the information collected by the mining registrars in the several districts of the colony, as follows:—Ballarat, 327,797 tons, yielding on an average 6 dwt. 16·97 gr. of gold per ton; Beechworth, 54,764 tons, yielding 10 dwt. 21·94 oz. per ton; Sandhurst, 258,758 tons, yielding 9 dwt. 20·41 gr.; Maryborough, 38,261 tons, yielding 17 dwt. 10·38 gr.; Castlemaine, 75,397 tons, yielding 6 dwt. 1·91 gr.; Ararat, 74,221 tons, yielding 14 dwt. 8·67 gr.; Gippsland, 35,518 tons, yielding 1 oz. 0 dwt. 21·69 gr. The quantity of wash dirt puddled or sluiced during the year 1878, compiled from the returns made by certain companies and individual miners, was 566,628 tons, and the yield therefrom 30,625 oz. 9 dwt., or an average of 1 dwt. 1·94 gr. of gold per ton. Information has been received respecting the crushing of 22,098 tons 15 cwt. of cement, which yielded 5,093 oz. of gold, or an average of 4 dwt. 14·62 gr. per ton. The number of miners employed on December 31 in each of the districts were as follows: — Ballarat, 8,246; Beechworth, 4,889; Sandhurst, 6,353; Maryborough, 7,375; Castlemaine, 4,901; Ararat, 2,893; Gippsland, 1,979; total, 36,636. The decrease in the number of alluvial miners continues. The number now employed is 11,318 less than in the year 1873; the number of men engaged in quartz mining since the same year has diminished by 2,641. The decrease in the number of both classes of miners, comparing the return for 1878 with that for 1877, is 1,369. The number of Chinese engaged in mining operations on December 31 was 9,368, showing a decrease of 238 as compared with 1877. Dividing the value of the gold exported and received in the Mint among the mean number of miners employed in the year 1878, the average per man is £82 12s. 11d¼.; the average among alluvial miners being £47 3s. 6¾d., and among quartz miners, £138 7s. 7½d. During the past six years the number of steam-engines employed in alluvial mining, has decreased by 122, and the number employed in quartz mining has increased by 7. The estimate of the value of the machinery and appliances in use on the goldfields of the colony during the year is £1,903,494, showing a decrease of £120,000 as compared with 1877. The approximate area of auriferous ground over which mining operations extended up to the end of 1878 is 1,290 square miles, and the number of distinct quartz reefs proved to be auriferous is 3,402. For the first time some of the shafts sunk in search of auriferous quartz veins have obtained depths in excess of 2,000 ft. from the surface. Two of the shafts at Stawell are 2,032 ft. and 2,014 ft, in depth respectively. The estimated value of the lands held under the bye-laws and under leases from the Crown in the mining districts of the colony is £4,626,368; it was nearly three times that value in 1873. The revenue derived by the Treasury from the goldfields from the mineral districts was £14,814. The number of mining companies registered during the year 1872 was 81; the number of shares, 1,035,968; and the nominal capital, £791,960. Of metals and minerals other than gold the most important items are as follow:—1,426 tons of copper ore were raised, and 4,457 tons smelted, from which 500 tons of regulus were obtained; 2,627 tons of antimony were raised, and 200 tons were smelted, from which 80 tons of regulus were obtained; 301 tons of iron ore were raised, which was smelted and produced 140 tons of metal. The quantity of gold exported and minted in the colony from the date of the first discovery to December 31, 1878, has been 48,012,670 oz. 11 dwt., at £4 per ounce, amounting to £192,050,682. The produce of silver from ore treated has been 127,538 oz. 9 dwt. 14 gr., valued at £31,885. The value of the tin and tin ore during the same period has been £343,775; copper, £44,640; antimony, £153,169; lead, £4,892; iron, £2,916; coal, £13,505; lignite, £2,367; kaolin, £7,444; flagging, £45,768.

PATENTS IN 1878.

The report of the Commissioners of Patents for Inventions for the year 1878 has lately been published. It contains the usual statistics as to applications for letters patent, grants, &c. The number of applications during the year 1878 was 5,343, being 394 more than the preceding year, and 274 more than the number in 1876, which was previously the highest known. Since 1870 there has been a steady increase in the applications, except in 1877, when there was a slight falling off; the numbers have mounted up from 3,405 to the 5,343 of last year. The growth of inventive ingenuity is strikingly shown by a chart at the end of the report (given last year and repeated with the needful additions this) from which it appears that from 1853 to 1866 there was a general, but by no means invariable iacrease, the numbers growing from 3,045 in 1853, to 3,453 in 1866. During this period the highest number was 3,490, in 1862, the lowest 2,764, in 1854. In the four years from 1866 to 1870, the numbers increased to 3,991 in 1868 but fell to 3,405 in 1870. From that year, as above stated, there is a rapid increase till 1876, then a slight falling off, to be followed by another rapid increase in 1878. A careful examination of the subject-matter indexes for the past three years might very possibly explain the causes of this ebb and flow, by showing in what subjects the chief increase took place.

Of these 5,343 applications, 3,438 only were proceeded with, and are now in force, 1,905 (or not very far from two-fifths) having been allowed to lapse at some stage or other of the first proceedings. It has been estimated that the fees paid for these applications could not amount to less, on the average, than £6 each; so that thus a sum of £11,430 was expended in a single year by the patent-taking community in this way alone. The future history of the 3,438 remaining patents may be readily calculated from the statement in the report that only about 30 per cent. of the patents (*i.e.*, completed patents, not applications receiving "Provisional Protection" only) from 1852 to 1871 paid the third year's stamp duty of £50, and continued in force to the end of the seventh year, while about 11 per cent. paid the seventh year's stamp duty of £100, and consequently remained in force for the full term of 14 years.

The number of specifications (or descriptions of inventions) filed from the 1st October, 1852 (when the Patent-law Amendment Act came into operation) to the 31st December, 1878, was 96,773. The specifications of patents under the old law (from the earliest period at which specifications were enrolled down to the year 1852) are 13,561 in number. The old and new law specifications to the end of 1878 amount altogether to 110,334.

The report, dealing as it does with the year 1878, of course puts officially on record much which has already been published in this *Journal* and elsewhere. Amongst such matters are found certain alterations in the proceedings for obtaining Letters Patent; the method of advertising applications; the employment of a special indexing staff of clerks to prepare a new subject-matter index for patents under the old law; the continuation of classified abridgments of specifications down to a recent date, &c. Of these abridgments, 92 classes are already complete, and it is expected that the work will require about 18 or 20 more. Seven of these have been brought down to 1876, the others stop at 1866. The completion, however, of all the classes is being continued, and it is intended for the future to carry them on in parts containing periods of ten years. The seven completed classes are—"Bleaching, Dyeing," &c.; "Photography;" "Purifying and Filtering Water;" "Agriculture;" Div. I., "Field Implements," and Div. II., "Barn and Farmyard Implements;" "Washing and Wringing Machines;" "Chains, Chain Cables," &c. A full list of these classes of abridgments is included in the report.

As regards the financial portion of the report, the surplus income of the present year shows an increase on that of last year, being £144,176, against £138,523 in 1877. The stamp duties on patents are, of course, more productive, in consequence of the larger number of applications. The receipts from the Designs Registry are nearly £500 more, but those from the registration of trade-marks are much smaller than last year, being £4,191, against £8,754. This is, of course, owing to the fact that the old trade-marks are now all on the register. Altogether the receipts of this year from all sources amount to £186,245, as compared with £183,720. The expenditure for this year amounts to £42,069, last year's having been £45,197. The saving appears to be chiefly in the item of printing, which is £11,275 this year, and was £13,316 in 1877, and in the charges for repairs, &c., which are only £740, against £2,230 last year. The aggregate surplus income, or amount gained by the Patent-office since the New Patent-law of 1852, was, at the end of 1878, £1,751,538. Besides the matters above referred to, the report contains statistics of the trade-marks and designs registered, lists of the places receiving grants of the Commissioners' publications, &c.

POPULATION, GOVERNMENT, AND EXPORTS OF SAIGON AND COCHIN CHINA.

Consul Tremlett, in his report upon the trade of Saigon and Cochin China, states that an interesting peculiarity may be mentioned concerning the aborigines, which is, that the great toe of each foot is separated from the others, like the thumb of the hand, and can be used in much the same manner, but, of course, in a limited degree: this is the meaning of the word "Giao-chi," or "Kiao-tchi," and is the native name for their race. It is still the distinctive mark of an Annamite, but it is not usually seen in the vicinity of Saigon, being now confined to the inhabitants of the more northern section of the Empire, where the race has remained more distinct. That this name and peculiarity are of great antiquity, is shown by their mention in Chinese annals, 2,300 B.C., in connection with one of the "four barbarian" tribes that then formed the boundaries of the Chinese Empire. Annam, or An-nam, is fairly interpreted as "the south pacified," a designation given it by a Chinese Emperor, whose idea of pacification probably included conquest. The words Cochin China have been placed to several derivations, of which the most probable are:—First, the Portuguese who first visited the coast found it similar to that of Cochin, and added "China" on account of its neighbourhood. Second, the Chinese characters which answer to "Co-cheng-ching" mean "Old Ciampa," and the latter was certainly the designation of the entire southern and eastern coasts at a remote period, and the name still attaches to sundry tribes in the vicinity of the sea. Third, Giao-chi, the native application.

The first of the Governors who ruled the colony after the conquest was Vice-Admiral Rigault de Genouilly, who landed at Saigon in the year 1859. Besides the usual staff, the Governor is assisted in his numerous functions by a Privy Council, consisting of the Commandant of the Troops, Director of the Interior, Procureur-General, Commandant of the Marine, Commissaire of the Marine, two civil members, and two civil members' assistants. The central bureau of administration for internal affairs, called the "Direction de l'Interieur," consists of a "Directeur," a chief secretary, and twenty-three subordinates: to this office all "inspecteurs" and "administrateurs" report and are subject. Besides these latter officials, there are Annamite functionaries to the number of fifty, who fill positions of "Préfet" and "Sous-Préfet" throughout the country. The naval force in ships on this station is not, and need not be, large. An old line-of-battle ship forms the

head-quarters of the Marine Department, and has a complement of some 500 men. The coast service is performed by a vessel or two of the sloop class, a moderate-sized transport, and a paddle despatch-boat; for river service are eight gunboats of good power, and carrying (when armed) one heavy gun. They employ altogether about 1,500 men. The military force is some 3,000, comprising portions of four regiments of the Infanterie de la Marine; besides, there are two batteries of artillery, and a force of gendarmes (horse and foot). The native troops number about 4,000, under their own officers up to a rank answering to general. It is probably not considered advisable to arm a very great number. These men are supplied by the villagers in proportion to the population, and are quartered about the country under the orders of administrators. The measurement of State lands is by no means yet completed, but the work has been pushed on as far and as fast as could reasonably be expected. These lands may be obtained by public auction, private agreement, exchange, or even, in certain cases, by free grant. Twenty days are allowed for payment in Saigon, and thirty in the interior. Private sales are made under the supervision of the Director of the Interior, subject to the Governor's approval, and no more delay occurs than is necessary to perform the work of transfer. Taxes are paid from the commencement of the year following the purchase. The number of scholars registered in the various schools is 2,679. "Quoc-ngu" is the name given to the method of writing the Annamite language in Latin characters, accentuated in order to give as nearly as possible the native pronunciation, and it being considered that this Quoc-ngu is now comparatively well known throughout the colony, and goes far towards increasing the direct intercourse between the administration and the natives—an object greatly to be desired. It has been ordered that, from 1881, all official acts, resolves, decisions, codes, instructions, and other public documents shall be written, signed, and published in Latin characters; from 1885, no person will be eligible for official positions unless he is sufficiently acquainted with and versed in Quoc-ngu.

The colony has not escaped the general depression experienced in all parts of the commercial world. The prices obtained for grain, although high as compared with those of other years, and with prices in foreign markets, were not so remunerative to agriculturists as to counterbalance the losses from short yield in many districts. The bulk of the crop having gone through Chinese hands to China, Europeans had little to do with it; and while the foreign trader cannot have done much more than pay expenses, Chinese exporters have lost heavily and steadily throughout the season. The principal export is rice, amounting to 215,813 tons, in 1878, or 84,915 tons less than the previous year, and for this article China is the chief customer. The other exports are gamboge, silk, hides and horns, salt, cotton, pepper; the trade in fish continues to hold its own, unlimited markets being found in Java and China, besides the enormous quantity consumed in the country itself. Consul Tremlett states that every year new tracts of land are brought under tillage, and, with the comparatively cheap labour so readily to be obtained from China, there appears no reason why this colony should not greatly increase its exports. In addition to the acreage under rice, sugar, tobacco, indigo, cotton, cocoa, and betel nut, experiments in coffee are still persevered in, but with no profitable result. Liberian coffee will, no doubt, be introduced shortly, and may do well. Roadside tree-planting is always going on, and in a few years streets and roads will present an improved appearance. The eucalyptus has been introduced to a considerable extent, but does not seem to take kindly to the soil, though it is yet too early to condemn it. Teal are found in all the branches of the rivers away from habitation, and, during the latter and earlier parts of the year, are numberless; the same may be said of snipe which afford good sport during the autumn months to the few "guns" of the colony; there are, besides, in small number, quail, partridge, rail, and a small pheasant. Peacock, though not easy shooting, are plentiful enough. Hare forms an agreeable addition to the few articles of food; and deer of many varieties reward the somewhat arduous labour required for their capture. Piracy having shown signs of reviving life, the selling of arms and ammunition has been stopped in the interior, and also in Saigon, except by European merchants.

THE VENICE AND MURANO GLASS AND MOSAIC COMPANY.

The report of Signor Francesco Sampieri upon the exhibits of glass at the Universal Exhibition of 1878, in Paris, contains some observations upon this ancient and historical branch of the art industries of North Italy, now carried on in a successful manner at the island of Murano. Without any pretensions to enter into competition with the vast collection gathered together from all quarters, Italy, in respect to glass, has confined herself to a simple display of the productions of Murano and Venice. Modest enough, from an industrial point of view, but of great interest when examined with the eye of an artist. Signor Sampieri mentions that the company upon this occasion had arranged a complete museum of the productions of the glass-maker, from ancient times down to the 16th century. The Greek and Roman specimens made in imitation of agate and calcedony, wherein are combined the most varied yet harmonious colouring, including the "murrhine" amphora described by Pliny. The crystal vases, ornamented with leaves of gold, the gilt enamelled Byzantine glass, and lastly the blown glass of Venice, of the 15th century, the apogee of modern art, with those of the 16th century—when both in form and ornamentation, the taste had, perhaps, somewhat declined—all these objects attracted the attention of artists, amateurs, and the cognoscenti in such matters, and a considerable number of the pieces were purchased immediately on the opening of the exhibition, by the principal museums and collectors of Europe.

Mons de Liesviller, in a contribution to the *Gazette de Beaux Arts*, says that for delicacy, rarity, and variety of colour, the manufactures of Venice and Murano hold the foremost place in the exhibits of glass; and, he adds, "that Italy thought justly that her glass could not be applied to the ordinary drinking purposes. She desired to imitate what Venice had already produced—the glass cups of curious and attractive forms, made in defiance of all the difficulties of art; to restore the veined patterns of former times; the gold *a granelli*, or the designs between two layers of glass. Behold, this is what Italy does, that is to say, Venice, for she is the sole exhibitor."

Signor Sampieri observes, in conclusion, that he was enabled, as one of the jurors, to draw the especial attention of his colleagues to the history of Venetian art from its origin, observing the stages of progress, its decay, and revival. The members of the jury, consisting, in great part, of manufacturers of glass, could well appreciate the marvellous results accomplished from 1867 to the present time. Such a conscientious examination has powerfully contributed to change any preconceived opinion as to the superiority of the French in comparison with the Venetian glass. Whilst the prospect opens out for the extended employment of the Italian people, Signor Sampieri cannot but regret that the sole Italian establishment which obtained a prize in Class 19, at the Universal Exhibition of Paris, belonged to a company of foreign capitalists.

Upon this subject, the Venice and Murano Company, in the prefatory remarks to the Exhibition catalogue, state

that the company was established in the year 1866, by a few English gentlemen, whose interest in Italian art induced them to subscribe the capital necessary to give a proper artistic and commercial direction to the revival of an industry for which Venice and Murano in their palmy days had acquired a world-wide celebrity. The task undertaken proved by no means so simple as at first sight it appeared. The workmen of Murano retained certain traditions of their art; but their taste had been vitiated by working from inartistic models, and time and patience were requisite before they could be brought to produce types worthy of their intelligence and powers of manipulation. The public taste also required the education which results from familiarity with art productions. Happily, however, by dint of perseverance and the outlay of considerable capital in making experiments, the difficulties, which at one time appeared insuperable, were overcome. The beauty of the forms—following the best known models—which the company now produce, combined with richness of colour, and application to articles of everyday use, produce an artistic result which has been publicly recognised by the award to the Venice and Murano Company of prize medals at all the principal international exhibitions in Europe.

In addition to the production of Soffiati, or blown glass, the manufacture of enamel glass, and its adaptation for mural decoration, after the manner so generally in use during the best period of the Middle Ages, has engaged the earnest attention of the company. But it was not until numerous costly experiments had been tried that they succeeded in reproducing the ancient smalti tints, which add so much to the delicacy and beauty of the mosaic works that have been produced at their ateliers (731, Campo San Vio) in Venice, and examples of which were to be found at the Exhibition. One of these Mosaics is interesting, as being a precise reproduction of one of the spandrils designed by, and executed under the supervision of, Raphael, in the ceiling of the Chigi Chapel, in the Church of Santa Maria del Popolo, at Rome. The Venice and Murano Company submit with confidence to the appreciation of the public, the collection of objects prepared by them for the Exhibition, and they hope that they may be considered to have attained a degree of excellence not unworthy of comparison with that which, in former days, characterised the productions of the glass workers of Venice and Murano.

NOTES ON BOOKS.

Water for Nothing. Every House its own Water Supply By Shirley Hibberd, F.R.H.S. London: Effingham Wilson. 1879.

The author of this pamphlet points out that the ultimate source of every possible water supply is at present neglected, and that every man has at his command the means of securing an abundant and perfect supply of water by the simple process of utilising the rainfall. The author further treats of the best methods of storing and filtering the rain water which is now wasted.

Remarks on the Assessment of Rateable Value on Hereditaments containing Machinery, with special reference to Laing *v.* the Overseers of Bishopwearmouth By Joseph Potts, jun. London: E. and F. N. Spon. 1879.

The recent decision in the Court of Queen's Bench, alluded to in the above title, having been supposed to settle the law as to the treatment of machinery in cases of a like character, the author has attempted to state in plain terms "the simple principles involved in making assessments of rateable value, and to indicate exactly what amount of the machinery usually found in manufactories is by law to be taken into account in making such assessments." He holds strongly to the opinion that there can be no such thing as rating machinery.

Text-book on the Steam-engine. By J. M. Goodeve, M.A. Second Edition. London: Crosby Lockwood. 1879.

Professor Goodeve has published a second edition of his book on the steam-engine. It deals rather with the theoretical principles involved, than the mechanical details. According to the author's own summary of the contents, the first part of the book gives a sketch of the steam-engine of Watt's time. Then comes an account of the physical properties of steam, and of the principles of the modern theory of heat in its application to the steam-engine. The "conversion of motion" is the next subject, then come the expansion of steam, the action of valves, the indicator. The next chapter relates to boilers and fuel, the next after that to compound cylinder engines, the last to "miscellaneous details." The book concludes with a series of examination questions.

Color Blindness: Its Dangers and its Detection. By B. Joy Jeffries, A.M., M.D. Boston: Osgood. London: Trübner. 1879.

This book is written throughout from a practical point of view. The author is chiefly occupied with a consideration of the practical effects of colour blindness and the dangers caused by it. These dangers are, of course, mainly in the case of persons employed on railways and in the not very numerous other occupations where the observation of coloured signals is important. The earlier chapters of the book deal with such matters as the history of the subject, the precise condition of the vision of the colour blind, physical peculiarities connected with colour blindness, the "concealment of colour blindness in actual life," sometimes unconscious, sometimes done on purpose, and such portions of the subject. Then comes a consideration of the dangers in practical life, and after this the detection. Here a description is given of Professor Holmgren's method. Strangely enough this detection is by no means so easy as it might be thought. It is said not to be sufficient to ask a person to name colours, or even to see that he can distinguish between such colours as red and green. By practice it appears that colour-blind persons can often detect slight differences of light and shade, which enable them to name correctly the colours placed before them. Professor Holmgren's plan is to prepare a collection of skeins of coloured worsteds, and then to require the person under examination to select from the heap the colours which he considers most nearly match a skein selected by the person making the examination. Dr. Jeffries states that by this system he can almost immediately and with certainty detect a colour-blind individual. The colours also which he selects show the sort of blindness from which he suffers, whether he is "green blind," "red blind," or wholly blind, the last being very uncommon.

GENERAL NOTES.

Paper from Wood.—In the period 1866-70, the amount of wood-pulp manufactured in Norway for paper annually was about 110 tons; in 1871-75, it was about 4,600 tons; in 1876, it reached 12,200 tons; in 1877, it was 14,900 tons; and in 1878, it rose to 19,000 tons. This last quantity represents a value of about 1,200,000 kroners, 18 kroners being equal to £1. The British Consul at Christiania speaks of the growing importance of the industry, and says that about 20 mills are at work in Norway on the preparation of this material.

Australian Meat Preserving.—A new method of preserving cooked meat has been patented at Sydney by Mr. Edward Naylor. The meat, after having been boiled, roasted, or steamed, is packed in wooden cases, and is then covered over with stearine, heated to about 250 degrees. The advantages claimed by this system are, that the meat does not lose any of its natural juices, and, as it has been deprived of most of its water during the process of cooking, the buyer does not lose so much by evaporation as he does in the case of uncooked meat. It is said that the stearine does not in the least affect the taste, and can be sold at a profit on its arrival in England.

Royal Horticultural Society.—The following are the arrangements decided upon for the meetings, shows, &c., for the year 1880:—Fruit and Floral Committees, Tuesdays, January 13th, February 10th, March 9th and 23rd, April 13th and 27th, May 11th and 25th, June 8th and 22nd, July 13th and 27th, August 10th and 24th, September 14th, October 12th, November 16th, and December 14th. Whit-Monday show, May 16th; great summer show, June 8th, 9th, 10th, and 11th; artisans' and cottagers' show, August 2nd (Bank Holiday); *conversazione*, Wednesday, May 26th; evening *fete*, Wednesday, July 21st. The date of the rose show and exhibition of the Pelargonium Society will be announced hereafter.

Factories.—A return has just been issued of the number of factories authorised to be inspected under the Factory and Workshop Acts, with the number of persons employed in each industry, distinguishing men, women, young persons, children, and half-timers; and also giving the number of spindles, looms, and other machines used in each of the trades and industries inspected, from which it appears that the total number of factories in the United Kingdom is 7 105 (6,189 in England and Wales, 675 in Scotland, and 241 in Ireland). The total number of persons employed is 374,199 males and 601,347 females. There were 251 factories entirely closed at the date of the collection of this return, the particulars of which are not included.

Use of Explosives in Mines.—A joint committee on explosives has been appointed by the Royal Cornwall Polytechnic Society, the Miners' Association of Cornwall and Devon, and the Mining Institute, to investigate the nature, economy, efficiency, and safety of various explosives in use or proposed for use in the mines of Cornwall and Devon. The first meeting of the committee was held at Redruth on Wednesday, the 8th October, when the following resolutions were passed:—1. That the secretary be requested to draw up a digest of experiments and reports on explosives already made by various public bodies, for the use of the committee. 2. That the secretary be requested to prepare a circular, to be addressed to proprietors of mines, mine managers, and others interested in mining, soliciting subscriptions to a fund for carrying on the investigations of the committee and bringing them to a practical issue. The secretary is Mr. J. H. Collins, 57, Lemon-street, Truro.

Hardened Glass.—M. de Luynes has recently communicated to the French Society of Encouragement, in the name of M. de Labastie, further information on the progress which the industry in hardened or tempered glass has recently been making. He showed to the meeting numerous specimens, which presented the most varied and accurate forms. There were tubes for lamps, both gas and oil, goblets of various forms, mortars and pestles, &c. As to the latter, M. de Luynes reminded the society how frequently accidents happened with them; the least fall breaks them, whereas with hardened glass they stand any amount of hard usage. He also showed capsules for pharmacy and chemistry, of all sizes and shapes, plates of glass, crystal and enamel, coffee and tea cups in white enamel, and he finished by making an experiment. Ordinary glasses were placed in a basket with drinking-glasses of the same shape in hardened glass; after several shakings, the ordinary glasses were all broken, while all the hardened glasses were intact. The processes of manufacture have also been simplified and combined with the ordinary operations of glass-blowing, so as considerably to diminish the expense and give more regular forms and more perfect execution. Objects made with the liquid material, when they are still red, are thrown directly into the tempering bath, and are not again heated to the melting point, as at first, which often causes a change in their form. Bottles, drinking-glasses, lamp-glasses, and other concave objects, containing air are received on a curved tube, a sort of siphon which at the moment of immersion allows the air to escape, while the liquid enters the cavity without difficulty. All these improvements have been adopted at the glass-works of Choisy-le-Roi, and it is expected that in a very short time objects in hardened glass will be quite as cheap as those made in the ordinary way.

Calculating Machine.—The "Arithmometer" or calculating machine of M. Thomas, of Colmar, which was invented in 1820, has since undergone many improvements at the hands of the inventor and latterly of his son, M. Thomas de Bojano, so that it is now offered in a form which M. Sebert, in a recent report to the Paris Société d'Encouragement, pronounced to be thoroughly adapted for practical use. The machine performs all ordinary arithmetical operations, comprising the extraction of roots. In the 44 years, from 1821 to 1865, only 500 machines were sold; in the 13 years from 1865 to 1878, 1,000—viz., 300 in the five years, 1865 to 1870, 400 from 1870 to 1875, and 300 from 1875 to 1878, or 100 a year. Of the latter number about three-tenths are six-figure machines, six tenths eight-figure, and only one-tenth ten-figure. Of 100 machines, sold, 60 go abroad and only 40 remain in France.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, NOV. 24TH...**SOCIETY OF ARTS**, John-street, Adelphi W.C., 8 p.m. (Cantor Lectures.) Dr. Charles Graham, "The Chemistry of Bread and Bread-making." (Lecture I.)

Institute of Surveyors, 12, Great George-street, S.W., p.m. Mr. J. Smalman Smith, "The Law of Fixtures."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Captain A. H. Markham, R.N., "The Arctic Campaign of 1879 in the Barents Sea."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Mr. F. B. Sprague, "The Rate of Remarriage among Widowers."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, NOV. 25TH...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. William Carson, "The River Services and the Light Draught Passenger Steamers of the Thames, the Mersey, and the Clyde."

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m.

Royal Colonial, "Pall Mall," 14, Regent-street, S.W., 8 p.m. Mr. Stephen Bourne, "Extended Colonisation, a Necessity to the Mother Country,"

WEDNESDAY, NOV. 26TH...**SOCIETY OF ARTS** John-street, Adelphi, W.C., 8 p.m. Major-General H. Y. D. Scott, "Sugestions for Dealing with the Sewage of London."

Society of Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. Mons. Felix Garay, "Note on the Use of Condensers."

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. C. F. Keary, "Some Aspects of Zeus and Apollo Worship."

Society for the Development of the Science of Education, Memorial-hall, Farringdon-street, E.C., 7½ p.m. Mr. C. H. W. Biggs, "Mathematics."

THURSDAY, NOV. 27TH...Royal, Burlington-house, W., 8½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

FRIDAY, NOV. 28TH...Quekett Microscopical Club, University College, W.C., 8 p.m. Dr. T. Spencer Cobbold, "The Fertilisation of Certain Flowering Plants."

SATURDAY, NOV. 29TH...Trade Guilds of Learning and Social Education League (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Free Lecture.

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FRIDAY, NOVEMBER 28, 1879.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. W. H. PREECE, on "Wonders of Sound" and "Wonders of Light." The dates for the lectures will be Friday, the 2nd, and Friday, the 9th of January next. The lectures will commence at seven o'clock. As the number of seats is limited, admission will be by ticket only, and when sufficient tickets have been issued to fill the Room, the issue will be discontinued. The tickets will be supplied strictly in the order in which applications are received. Subject to these conditions, each member is entitled to a ticket admitting two children and one adult. The tickets will shortly be issued, and members requiring them are requested to make application to the Secretary at once.

PARIS EXHIBITION.—ARTISAN REPORTS.

The selected Reports on the Paris Exhibition, made by the artisans who were sent out last year by the Society of Arts, have now been published by Messrs. Sampson Low and Co.

The price of the volume is 7s. 6d. Members of the Society of Arts, and Exhibitors at the Paris Exhibition, can obtain copies from Messrs. Low and Co. for 5s. 8d. each.

Besides being published in a single volume, the reports have been issued in 11 divisions, making 12 parts in all.

In the hope that these parts may prove acceptable and serviceable to the classes interested in each particular industry, they have been issued at the price of 6d. each. Twelve copies of any of the parts will be supplied at 4s. 6d.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 26th, 1879; Lord ALFRED S. CHURCHILL, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Brookes, E., 2, Rood-lane, E.C.
Colfox, Thomas Alfred, Westmead, Bridport.
Fox, Samson, Castleton-lodge, Leeds.
Guthrie, Charles, 88, Cannon-street, E.C.
Holme, Charles, F.L.S., 4, Ornan-road, Haverstock-hill, N.W.
Mathers, Alderman John Shackleton, F.S.S., Hanover-house, Leeds.
Mitchell, Henry, 39, Mecklenburgh-square, W.C.
Perceval, Charles John, 8, Thurloe-place, South Kensington, S.W.
Roberts, Thomas David, The Grove, Malpas, near Newport, Monmouthshire.
Simpson, Thomas, Audrey-lodge, Ealing, W.
Smeaton, John, 24, Moorgate-street, E.C.
Vernon, Arthur, High Wycombe.
Yerburg, Armstrong, 5, Queen-street, Mayfair, W.

And as Honorary Corresponding Member:—

Jäger, Dr. J. G., Rokén 87, Amsterdam.

The paper read was:—

SUGGESTIONS FOR DEALING WITH THE SEWAGE OF LONDON.

By Major-Gen. H. Y. D. Scott, C.B., F.R.S.

In compliance with a resolution passed by the Metropolitan Board of Works in November, 1857, a report was presented to them in the following year, by Messrs. Bidder, Hawksley, and Bazalgette, on the "Main Drainage of the Metropolis." In this report, the Metropolitan Board were told:—

"The referees say (Report, p. 9):—'It would also appear that the black mud from the sewage contains a considerable quantity of organic matter, which is most deleterious; an immense mass of this fœtid mud has accumulated in the bed and on the banks of the river, and it is continually supplying to the water large amounts of soluble matter in a state of putrescence, and contaminating the atmosphere with most offensive emanations. It is probable that the unhealthy condition of many towns on the sea coast is caused by deposits from the sewers by mud of this character."

"And Dr. Hofmann and Mr. Witt, at p. 7 of their report, employ the following forcible expressions:—'We cannot but emphatically insist upon it—that the formation of this mud-deposit in the river appears to us by far the most serious evil which results from the discharge of the London sewage into the river. We cannot too strongly urge this point upon public attention.' In these conclusions (say Messrs. Bidder, Hawksley, and Bazalgette) we entirely agree, and although we are not disposed to think that the whole of this noisome mud results from the deposition of sewage matter, yet we are satisfied that a real and increasing evil has its origin in this source, and that this evil has already attained such proportions as to render it essential to the well-being of the metropolis that

means should be taken for its immediate and permanent abatement."

"Any person who examines the state of the Thames, especially within the tidal reaches, whether above or below the metropolis, will be satisfied that the periodical withdrawal of the water of the river from the muddy surface of its bed is, in the hot weather of summer, invariably succeeded by disagreeable emanations, only too plainly indicative of the decomposition of animal and vegetable organisms."

The main drainage of the metropolis was eventually carried out in accordance with the recommendations of this report, so far as concerned carrying all the sewage to the present main outfalls. Since 1866, these outfalls have been in full operation, and have daily discharged the raw sewage of the metropolis between the towns of Woolwich and Erith, the results being precisely such as might have been expected from the above evidence. It is true that, inasmuch as the sewage is now discharged into a larger body of water than formerly, and at a point more distant from the great centre of population, the evil effects are considerably mitigated, but they are the same in kind, and in 1877, Captain Calver reported to the Conservators of the Thames, by whom he had been commissioned to examine into the question, that the Metropolitan Board of Works ought "to be called upon at once to dredge away those portions of the accreted matter which interfere with the convenience of navigation;" and he concluded his report with an expression of his "hope that the sanitary and economical difficulties may, ere long, be solved, so that the noble metropolitan river committed to their (the Conservators') care may be freed from a drawback which is impairing its convenience and usefulness, and which must continue to do so at an increasing rate without an effective remedy is speedily applied."

The Metropolitan Board, on the other hand, contend that the discharge of the raw sewage is neither damaging the river navigation nor the health of the dwellers on its banks, and Sir Joseph Bazalgette maintained at the Institution of Civil Engineers:—

"That the bed of the river had improved of late; that the improvement was not due to systematic dredging; and that the mud banks were not formed by sewage."

Without entering further into the arguments adduced on either side, it is necessary, for the basis of my reasonings, to point out clearly that the three engineers nominated by the Metropolitan Board, to report to them on the main drainage of London, laid before them the following conclusions, which, indeed, having quoted the above-recited evidence, it would have been difficult not to have arrived at, viz.:—"That mud, containing much organic matter, derived, in great measure, from the sewage discharged above low water mark, is deposited on the foreshores of the river, and there putrefies;" and, "That the condition of the stagnant mud is injurious to health" (Report, p. 95). Further argument is not necessary to show that what was true with respect to the admission of sewage into the river at several points, situated in and about London, must be true, though to a minor degree certainly, when the sewage is thrown into the Thames by two outfalls between Woolwich and Erith. It is impossible to believe that the organic matter of the sewage will wholly lose either its tendency to deposit on the bed of the river, or to putrefy when there, whatever changes may be made in the situation of the outfalls.

The liquid and richest portion of the sewage of the 3,500,000 souls in London, who contribute to the contamination of the Thames, is, in the opinion of all chemists, after its admixture with water, irrecoverable, unless it can be utilised by irrigation; while the solid suspended matters—which all the Royal Commissions on sewage disposal have, one after the other, declared to be the most injurious part of sewage impurities—if they could be recovered, and be made into portable manure, would each year be worth more than a quarter of a million of money.

That it is possible to accomplish this object to a large extent, I hope to be able to prove to you, in spite of all that has been said and written concerning the worthlessness of sewage manures. In this matter, as in many others, English people have rushed into extremes. From unbounded and childish trust in the wildest schemes, they have now ceased to put faith in any.

The object of this paper is, then, to show that if the investigations and analyses of the most eminent living chemists are correct, it follows that sufficient value can be recovered from the suspended matters of metropolitan sewage, obtained by simple subsidence, and unmixed with bulky precipitating materials, to meet all the expenses of keeping such an offensive and injurious matter as solid sewage out of the Thames.

The first point for consideration will be the composition of the suspended matters of sewage, being those which I propose to utilise, and which, however deposited, whether by simple subsidence, or precipitation by chemicals, are termed "sludge."

These matters consist, 1st, of the *débris* of human fæces, mingled with the solid dejections of animals washed from stables, court-yards, and the streets, and also of the *débris* of animal and vegetable refuse from our kitchens; and 2nd, of the mud and sand scoured from the streets. The first-named constituents possess nearly the whole of the manurial value, and it is important for our inquiry to ascertain of what fertilising elements the fæces of a population consist. By ascertaining the proportion of these elements to the organic matter associated with them, we can arrive at the value of such refuse matters as consist partly of fæcal and partly of other organic substances.

The researches of Lehmann, Wolf, Röderer, and Eichhorn, from which tabular extracts are given by the Rivers' Pollution Commissioners (1st Report, p. 27), enable us to arrive at the composition of fæces with great certainty; and the analyses and investigations of Professor Way, carried on at Rugby, under the auspices of the Royal Commissioners on the disposal of Sewage, will, when considered in the light given by the above extracts, assist us materially in arriving at a conclusion respecting the valuable elements derived from other sources. With respect to the second class, or the detritus, as this is worse than useless, it may be rightly designated as a "profligate associate," deserving no other consideration than how to lessen it, since it still further degrades the value of a manure already too poor. In Paris, where they are rapidly carrying out a system which allows the solid fæcal

matters to be recovered without admixture with detritus, the contractor can afford to collect them for the fertilising elements which they contain; but we must deal with the matters as they arrive at the outfall, in which state the worthless ingredients greatly exceed in amount those which have a value.

The tables of Röderer and Eichhorn, above alluded to, give the annual weight of the fæces of a mixed population of 100,000 persons as 64,937 cwt., consisting of 957 cwt. of nitrogen, and 1,347 cwt. of phosphates, which, reckoning the phosphate as tribasic calcic phosphate, will amount to 622 cwt. of phosphoric acid, and this assumption we may make without important error.

From these figures it would appear that the nitrogen is to the total weight of the fæces as 1 is to 67·8, or deducting the water, which constitutes three-fourths of the total weight of the fæces, the nitrogen is to the organic matter as 1 to 16·9; and the phosphoric acid is to the organic matter as 1 to 26.

At p. 29 of the 3rd Report of the Commissioners on the distribution of sewage, are given the results of Professor Way's experiments at Rugby, extending over two and a half years, samples being taken every two hours out of the twenty-four. This series was divided into three periods, and subsequently two sets of samples were collected for five days a year later, and the ratio of the nitrogen to the organic matter, other organic refuse being now mixed with the fæces, will be found to be on the average as 1 of nitrogen to about 15 parts of organic matter.

From these results we can conclude, without much danger of error, that the sludge of the Rugby sewage, omitting all mineral detritus, is at least as rich as fæces, in that most important element, nitrogen. As respects phosphoric acid, though it was otherwise at Rugby, no great difference exists in the case of London sludge, as compared with fæces, as will presently appear. From the above different observations and sets of samples, the ratio of the phosphoric acid to the organic matter was for the Rugby sludge as 1 to 31·6.

At p. 47 of the Report on Metropolitan Drainage by Hofmann and Witt, an analysis is given of the insoluble as well as of the soluble portions of the sewage from Dorset-square, London, from which it appeared that the amounts of the above-mentioned substances per gallon were as 1 of nitrogen to 10 of organic matter; and 1 of phosphoric acid to 14·2 of organic matter.

Again, from some samples of sludge deposits, collected hourly throughout the day at Ealing, which were very carefully analysed by Mr. Shepheard, F.C.S., in the laboratory of Dr. Frankland, the following results were obtained as the ratio of the nitrogen and phosphoric acid to the organic matter:—

$$\frac{\text{Nitrogen}}{\text{Organic matter}} = \frac{1}{26{\cdot}5} \qquad \frac{\text{Phosphoric acid}}{\text{Organic matter}} = \frac{1}{27{\cdot}7}$$

The foregoing sets of experiments were made under such different conditions as to time and place and length of trials, that it is somewhat difficult to arrive at a fair mean. But an unobjectionable course, perhaps, will be to compare the highest and lowest results with the composition of fæces, as given by Röderer and Eichhorn, and take care to err, if we do err, on the side opposed to that which we are endeavouring to prove. These results are as follows:—

	Highest result.	Lowest result.	Mean result.	Fæces.
$\frac{\text{Nitrogen}}{\text{Organic matter}} =$	$\frac{1}{10}$	$\frac{1}{26{\cdot}5}$	$\frac{1}{18{\cdot}2}$	$\frac{1}{16{\cdot}8}$
$\frac{\text{Phosphoric acid}}{\text{Organic matter}} =$	$\frac{1}{14{\cdot}2}$	$\frac{1}{31{\cdot}6}$	$\frac{1}{22{\cdot}9}$	$\frac{1}{26}$

Dr. Letheby, after carefully comparing the results of his own analyses, which were very numerous, with those of Drs. Way and Voelcker, and the figures adopted by Drs. Hofmann and Witt in their investigations, came to the conclusion that in the suspended matters of town sewage the ratio of the nitrogen and the phosphoric acid to the organic matter, was—

	From excreta.	From all other refuse.	From all sources.
$\frac{\text{Nitrogen}}{\text{Organic matter}} =$	$\frac{1}{15{\cdot}5}$	$\frac{1}{36{\cdot}6}$	$\frac{1}{20{\cdot}6}$
$\frac{\text{Phosphoric acid}}{\text{Organic matter}} =$	$\frac{1}{16{\cdot}9}$	$\frac{1}{18{\cdot}7}$	$\frac{1}{17{\cdot}96}$

It would appear, from a consideration of the foregoing results, that, in different towns, owing to the influence, chiefly, of other refuse than excreta, the ratio of the fertilising elements to the organic matters may vary considerably; but, looking to the results of the examinations of the Dorset-square sewage by Dr. Way, we may feel some confidence that the chief fertilising elements in the London sewage sludge will be under, rather than over, stated, if we assume that—

$$\frac{\text{Nitrogen}}{\text{Organic matter}} = \frac{1}{20} \qquad \frac{\text{Phosphoric acid}}{\text{Organic matter}} = \frac{1}{25}$$

The potash is the third and only remaining valuable element found in sewage sludge, and, according to Letheby, it owes its presence entirely to the fæcal matters. Any potash present with granite detritus is not in a condition immediately available for plant life, and cannot, therefore, be reckoned as of any manurial value. From Way's analysis, the proportion of potash to organic matter in fæces is as 1 to 18·6, but, from the analyses made by Dr. Voelcker, of the precipitated sludges of four towns named in Messrs. Rawlinson and Read's report, viz., Bolton-le-Moors, Bradford, Coventry, and Leeds, all of which, excepting Coventry, are deficient in fæces, the mean ratio is—

$$\frac{\text{Potash}}{\text{Organic matter}} = \frac{1}{51}$$

and from Dr. Way's analysis of the sludge of the Dorset-square sewer, already referred to, the potash appears to have equalled the $\frac{1}{56}$ part of the organic matter; I therefore adopt the $\frac{1}{56}$ as the proportion of potash likely to be found in the metropolitan sludge. Recapitulating the results we have arrived at, we may assume then that with each part of the three fertilisers—nitrogen, phosphoric acid, and potash—there will be associated in the sewage sludge of London 20 parts, 25 parts, and 56 parts respectively of organic matter.

We have now to see to what extent these results will be influenced by admixture with detritus—the third, and by far the most variable, as well as the most worthless, component of sludge. The detritus should on every account be excluded,

as far as possible, from the sewers. At present, however, I shall limit my observations to the separation of the detritus from the more valuable organic matters when the sewage reaches the outfalls, with a view to its exclusion from the manure to be prepared from the sludge, as well as to its exclusion from the river. That this can be effected to a considerable extent will be evident from the valuable report of Captain Calver, from which I have already quoted. Captain Calver gives, at p. 16 of his report, two analyses by Professor Williamson; the first stating the amount in grains per gallon of the suspended and dissolved constituents of the sewage as it issued from the northern outfall sewer; the second—the amount, similarly stated, of the suspended and dissolved constituents of the sewage as it flowed from within the apron of the reservoir, into the Thames two hours after high water, that is to say, after the velocity of the current was diminished and the sewage had deposited the heavier particles.

Contents in Grains per Gallon.

Suspended Matters.	No. 1. One hour before low water.	No. 2. Two hours after high water.
Organic matters	37·24	104·97
Sand	44·10	23·52
Iron, alumina, carbonate of lime, &c.	26·67	23·01
Total suspended matters	108·01	151·50

For No. 1 analysis the $\frac{\text{organic matter}}{\text{mineral}} = \frac{1}{1\cdot9}$

and

For No. 2 ,, ,, $= \frac{2\cdot25}{1}$

The suspended matters in the sewage, when issuing from the sewer into the reservoir, contained only 34 per cent. of organic matter, and as the sewage issued from the reservoir into the river, the suspended matters contained, at one period of their flow, about 70 per cent. of organic matter. To this extent, therefore, it is manifestly possible to effect a separation of the sand from the more valuable constituents of the sewage. We require only, for the purpose of this separation, an additional reservoir for the subsidence of the lighter organic matters, after the heaviest mineral particles have been deposited in the existing reservoir.

From this second reservoir, in which I would propose that the sewage should have a period of quiescence, we might expect the sludge to show the following analysis:—

Organic matter (without nitrogen)	66·50
Nitrogen	3·50
Phosphoric acid 2·80 = tribasic phosphate of lime	6·07
Potash	1·25
Sand and inert mineral matter	22·68
	100·00

a result which corresponds very nearly with the composition of the sludge at Ealing, analysed by Mr. Shepheard, already referred to. It is a little richer in nitrogen, however, as was to have been expected from the analysis of London sludges by Professor Way.

I should here remark that different analyses of London sewage vary considerably in the proportions of the mineral and organic matters. Letheby determined that the—

$$\frac{\text{Organic matter}}{\text{Mineral matter}} = \frac{1}{1\cdot36}$$

It would appear, however, from the analyses of London sewage given in the Rivers Pollution Commissioners' first report, to be—

$$\frac{\text{Organic matter}}{\text{Mineral matter}} = \frac{1}{1\cdot55}$$

and Professor Williamson's analysis, from Captain Calver's report, gives—

$$\frac{\text{Organic matter}}{\text{Mineral matter}} = \frac{1}{1\cdot9}$$

As the detritus imparts no value to the sludge, but has a contrary effect, we shall err on the safe side if we assume, as Captain Calver states, that—

$$\frac{\text{Organic matter}}{\text{Mineral matter}} = \frac{1}{2}$$

And we see that by a period of repose we may easily bring the ratio to—

$$\frac{\text{Organic matter}}{\text{Mineral matter}} = \frac{2}{1}$$

We must next inquire into the values of the fertilising ingredients of the sludge, viz., the nitrogen, calcic phosphate, and potash.

It is usual with agricultural chemists to consider the nitrogen, associated with organic matter which freely decomposes, to be as valuable as nitrogen in the form of salts of ammonia; for instance, in guano, of which about one half the nitrogen exists in the form of ammoniacal salts, and the other half as nitrogenised organic matter, which has still to pass into the form of ammonia before it becomes operative on vegetation, this latter half is considered as valuable as the first, owing to the quickness with which it changes into the ammoniacal condition. In night soil, the rapidity of its decomposition also raises its nitrogen to the rank of nitrogen in the form of salts of ammonia; but when fæcal matters have been washed with water, so that they become less liable to putrefaction, and are mixed with other nitrogenous compounds, such as hair, vegetable *débris*, &c., which do not so readily decompose, some deduction from the value of the nitrogen should be made. Accordingly, Dr. Voelcker, when analysing different samples of sewage manures for the report on sewage disposal, by Messrs. Rawlinson and Read, whilst assigning to the nitrogen the same value as if it existed as ready-formed ammonia, stated expressly that he did so in order to avoid the charge of having put too low a value upon these manures; and in speaking on the same subject at the Institution of Civil Engineers, on the 28th March, 1876, the price of ready-formed ammonia being at that time 16s. per unit, he said that 15s. per unit would be too high for the value of nitrogen, reckoned as ammonia, before its conversion into such. Consequently, Dr. Voeleker estimated that the calculated value of nitrogen, not already converted into ammonia, should be less than the value

of ready-formed ammonia by at least 6½ per cent. on the value of the latter. Probably, therefore, we may safely calculate nitrogen, before conversion, as being worth 10 per cent. less than the market value of nitrogen in ammoniacal salts, such as sulphate of ammonia. The market price of this substance is at present 20s. per unit. I will, therefore, take the nitrogen at 18s. per unit. Concerning the the value of phosphoric acid, which varies considerably as it exists, in a condition either of insolubility or of solubility, I must speak at some length; this material being one I propose to add to the sludge, as I shall hereafter explain, in such a manner as to convert this ingredient into precipitated phosphate of lime. Any error in its assumed value is, therefore, of especial importance.

Dr. Voelcker made a very exhaustive series of experiments for the Royal Agricultural Society on the solubility of phosphatic materials, and he drew the following conclusions amongst others from his investigations. "Pure and dried phosphate of lime is sparingly soluble in water."

"In a moist state, and in the voluminous condition in which it is obtained by precipitation from its solution, it is about four times as soluble in water as it is after it has been dried and heated."

"The earthy phosphates in Peruvian and phosphatic guanos, still containing a good deal of organic matter, or salts of ammonia, are sufficiently soluble in water to be readily appropriated by plants." And in a letter to me, Dr. Voelcker writes, "the absence of acidity in the manure is an advantage when it is applied to land deficient in lime. There are many such soils, and on these phosphoric acid, in the shape of precipitated phosphates, produces a better effect upon vegetation than phosphoric acid in the shape of an acid soluble superphosphate, for unless the acid is rapidly neutralised by the alkaline elements (notably, the lime in the soil) and precipitated in the soil, it cannot benefit the crop to which the superphosphate is applied. On the other hand, if there is a sufficient amount of lime or of other basic constituents in the land to precipitate the phosphate in superphosphate, I consider it better, as regards the distribution of phosphoric acid in the land, to apply the manure in the shape of superphosphate than in the form of precipitated phosphate. It is, moreover, impossible to distinguish by chemical means, with any degree of accuracy, precipitated from ordinary phosphate of lime, and, in consequence, purchasers of manure will regard a guaranteed per-centage of phosphates, actually soluble in water, with more favour than a guaranteed per-centage of insoluble phosphates which may be present in a manure, partly as precipitated, and partly as ordinary insoluble phosphates;" and he suggests that a firm should sell manure, in which precipitated phosphates occur in plenty, "without any analytical guarantee, but on an established reputation for introducing into the manure precipitated phosphates only," and thus "give the public a reasonable guarantee they are really present in a precipitated form."

It would appear, then, that Dr. Voelcker looks upon precipitated phosphates as being intrinsically little inferior, and for some soils, superior to acid superphosphate, and as far as agriculture is concerned, the precipitated might be substituted for the perfectly soluble phosphate, without appreciable loss of manurial efficacy. The difficulty lies in the analysis, and is essentially a technical one, which it is to be hoped chemists will find the way of overcoming, as precipitated phosphates are brought more into use. Indeed, there are some who are already commencing to listen to the complaints raised against such unjust valuations of manure as are given by chemists in respect of precipitated phosphates, and Mr. Sibson, in his useful little work on artificial manures, says—"The identification of this form of phosphate (reduced or precipitated phosphate) being thus often a matter of importance, I now give its approximate amount when so required; at the same time, I should plainly state that I consider it distinct from soluble phosphate," and he gives the following scale of prices per unit, for fertilisers for 1878, such prices "being intended to apply to the purchase of manures under the circumstances usually prevailing in agricultural districts, when they are supplied in bags, carriage paid, and credit given. When bought in quantities, in bulk, for ready money, or fetched from the works, of course a lower scale would apply":—

Price per unit for—	s.	d.
Soluble phosphate	4	6
Ditto in mineral superphosphates	4	0
Precipitated phosphates	3	6
Insoluble phosphate (bone or guano)	2	6
Insoluble mineral phosphate, up to 7 per cent.	1	0
Potash sulphate	3	6
Ammonia	20	0

There can be no doubt that precipitated phosphates mingled with the decomposing matters of sludge, a very putrescible substance, are, under conditions, highly favourable to solubility. As may be seen, from the investigations of Dr. Voelcker, ammoniacal salts materially increase the solubility of phosphates. And since, as is well known to chemists, phosphate of lime is easily soluble in carbonic acid, and both ammonia and carbonic acid result from the decomposition of the organic substances, there seems no reason for giving to precipitated phosphates in sludge-manures a lower value than that assigned to them in Mr. Sibson's table, under the terms of sale to which that table is intended to apply. To the phosphates naturally accompanying the organic matters which the sludge contains, we should assign the same value as in the case of bone or guano.

Let us now investigate the cost of producing precipitated phosphate of lime, intermingled with sludge. I should premise that, as our object is not the preparation of a dry superphosphate, such as is manufactured for the market, a much freer supply of water is admissible than in the ordinary process of manufacture, where a dry powdery condition is essential in the finished product; a condition, moreover, somewhat difficult to obtain. The use of plenty of water much facilitates the process of solution, by enabling the acid to act more freely and perfectly on the mineral. It also does away, in great measure, with the noxious fumes evolved in ordinary superphosphate making, so that the process can be carried on without any extraordinary precautions. The mixing may be effected in strong wooden troughs, about 9 ft. by 4 ft. by 3 ft., pitched inside, and the dilute acid and mineral, finely powdered, should be stirred together for some minutes, until all action ceases. For one charge of a vessel such as the above,

there will be required about 20 cwt. of Cambridge coprolites and 17 cwt. of brown sulphuric acid; or if mineral phosphates, with less carbonate of lime than Cambridge coprolites, be used, a little less acid is needed. Enough water should be used in order to leave the mixture in a more than semi-fluid condition, in a state in fact which admits of being readily mingled with the sludge; this sludge must have previously had mixed with it a sufficiency of milk of lime to leave the mixture alkaline after the application of the phosphoric acid.

The cost of bringing the phosphoric acid into solution, and of adding the lime, will be as follows. I obtain the proportions, excepting for the lime and the water, from Mr. Sibson's work on artificial manures, from which I have also taken the above account of a suitable mixing trough:—

20 cwt. of Cambridge coprolites, ground ..	£3	5	0
17 ,, of brown acid at £4 0 0	3	8	0
5¼ ,, of quicklime at 16s.	0	2	8
9 ,, of water	*nil.*		
Labour of mixing 2¼ tons of dry solid matters and wear and tear of troughs	0	2	4
2¼ tons of dry solid matter, containing 1,600 lbs. of tribasic phosphate of lime, cost	6	18	0

Being a little less than 2s. per unit for a material which Mr. Sibson values at 3s. 6d. per unit, delivered to the consumer in bags, carriage paid.

There would then appear to be a fair profit on the treatment of phosphatic materials, if introduced in this way, into a manure which would find a market. I shall now proceed to show that there is every probability of being able to dispose of this manure at a price approaching that at which its constituents would be valued by chemists.

Let us first, however, consider the value of the fertilisers already existing in the sludge, to which it is proposed to add lime, and subsequently a solution of superphosphate, and thus to precipitate the soluble phosphate. From the scale of prices by Mr. Sibson, given above, we shall have to deduct from the value assigned to ammonia 10 per cent., owing to the fact that in sludge that compound has no existence, nitrogen only, capable of forming it, being present. This will reduce the value to 18s. per unit, and our figures will stand thus:—

66·50 organic matter (without nitrogen) ..	*nil*		
3·50 nitrogen (= 4·25 ammonia at 18s. per unit)	£3	16	6
6·07 phosphate at 2s. 6d. per unit	0	15	2
1·25 potash (= 2·30 sulphate of potash, at 3s. 6d. per unit)	0	8	0
22·68 sand and other minerals	*nil*		
100·00	£4	19	8

In order to ascertain the quantity of precipitated phosphate which should be added to the manure, let us see what proportion is necessary to give the utmost effect to the above amount of ammonia. I should here point out that phosphates have been proved to be the ingredients without which plants cannot thrive, or even live. If any of the other mineral elements found in plants are absent from a soil, the plants may become stunted, and bear a very low crop of fruit, but they pass through the cycle of life; if phosphates are absent, however, they die. "Phosphates, therefore, not only aid themselves in the nutriment of plants, but they determine the beneficial action of the other mineral ingredients;" and, as Liebig says, "the phosphoric acid insures and increases the action of the ammonia." Dr. Voelcker is of opinion that, for a manure for general purposes, the proportion of the phosphate of lime should be to the ammonia of the manure as 4 is to 1. M. Ville specifies that the phosphate of lime should be to the ammonia in ratios varying from about 4 to 1⅓ to 4 to ½, according to the nature of the crop. If we assume, therefore, Dr. Voelcker's decision to be approximately correct for a general manure, we shall have to add to the sludge about 8¼ per cent. of precipitated phosphate, after which its composition and value would stand thus. But in order to avoid any appearance of making out too good a case for my project, I will value the finished manure on a scale which can scarcely be cavilled at by the most arrant unbeliever in the efficacy of sewage manure. The valuation of the ammonia is that adopted by Dr. Voelcker in Messrs. Rawlinson and Read's report, namely, 8d. per pound. This price was based on the then market price, which was unusually low.

50·15 organic matter (without nitrogen)	*nil*		
2·64 nitrogen (= 3·21 ammonia) at 15s. per unit	£2	8	2
4·58 phosphate associated with the sludge at 2s. per unit	0	9	2
8·23 precipitated phosphate (added to sludge at 2s. 6d. per unit)	1	0	7
1·73 potash sulphate (= ·9 potash at 3s. 9d. per unit)	0	3	4
16·08 sulphate of lime, &c., from superphosphate	*nil*		
16·55 sand, &c.	*nil*		
99·96			
Value estimated on the manure in the perfectly dry condition	£4	1	3

Dr. Voelcker, in reporting to Messrs. Rawlinson and Read on samples of sludge manure submitted to him by them, says that:—"It is manifestly practically wrong to estimate the money value of such bulky and poor manures by the same standard of prices at which the commercial value of guano, bone dust, sulphate of ammonia, and similar concentrated artificial manures are estimated. A more rational and correct estimate of the true value of sewage and night soil manures is attained by comparing them with ordinary farm-yard manure, and the price which is paid for the latter," and he expresses the opinion that the utmost a farmer can afford to pay for good dung of the theoretic value of 15s. per ton, if he has to cart it half a mile, would not exceed 7s. 6d., or half its estimated value.

On the other hand, he thinks that manures sell better at the value of £8 8s. per ton, than if they have a higher value. Manifestly, therefore, if he is right in his view, at this price the theoretic and market values of manures should coincide. I think, indeed, I might venture to say, that he considers that they do so, even at the price of £6 per ton. Some deduction, in any case, must be made therefore, from the value at which the above estimate of the mixture of prepared sludge and precipitated phosphate works out, and what this deduction should be may, perhaps, be best arrived at by following the course pursued by Messrs.

Hofmann and Witt, to show the disadvantages of feeble manures. I may then, for simplicity's sake, suppose the one manure to have a value of £8, the other of £4, without entailing an error of any consequence. Thus:—

Price of one ton of good manure at the factory	£8	0	0
Spreading	0	0	9
	£8	0	9
Price of two tons of sewage manure at factory	£8	0	0
Spreading	0	1	6
	£8	1	6
Price of one ton of good manure at factory..	£8	0	0
Carriage for two miles	0	2	0
Spreading	0	0	9
	£8	2	9
Price of two tons of sewage manure at factory	£8	0	0
Carriage for two miles	0	4	0
Spreading	0	1	6
	£8	5	6
Price of one ton of good manure at factory..	£8	0	0
Carriage for five miles	0	5	0
Spreading	0	0	9
	£8	5	9
Price of two tons of sewage manure at factory	£8	0	0
Carriage for five miles	0	10	0
Spreading	0	1	6
	£8	11	6

Therefore, at a distance of five miles, there is a relative disadvantage in using the sewage manure of 5s. 9d.; and, at a distance of two miles only, of 2s. 9d. If we say, then, that the manure—allowing for 10 per cent. of water, which it should contain—has a value of £3 10s. per ton, we probably shall not be far from the price which would be given for it by farmers, when once they understood its merits, within a radius of four or five miles from the manufactory. In such situations as those which would be occupied by the works on either side of the river, the market would by no means be limited to a radius of five miles from them; for, with water carriage, the farmers along the whole course of the river would probably draw their supplies of manure from these factories. If the sales would even cover the expenses of manufacturing the manure, as the process would be the means of keeping the most deleterious part of the sludge out of the river, it manifestly would be inexcusable to continue to throw the solids into the Thames. Let us see, then, what these expenses would be.

The first operation, when the supernatant water is drawn off from the deposit (which will consist of about nine parts of liquid to one of solid), is to add to the sludge about two-thirds per cent. of quick lime, slaked, and made into milk of lime. This is effected by running the milk over it, and then stirring the compound, which will effectually deprive the sludge of noxious smell. The next step must be to mix with the limed sludge such a quantity of the prepared superphosphate as will nearly, but not quite, neutralise the lime previously added. The mixture now becomes surprisingly inodorous, considering the origin of the greater part of it; the organic matter also loses its slimy, glutinous nature; and assisted by the precipitated phosphates and the crystalline sulphate of lime, intimately incorporated with it, the compound drains and dries with comparative rapidity.

These additions will cost for materials about 16s. 6d. per ton of prepared manure, as may readily be seen by valuing the precipitated phosphate contained in it at the 2s. per unit which we found to be the cost of making it. To remove the sludge from the tanks and to dry it, including all the expenses of treatment, except the cost of building tanks, will amount to about 20s. per ton. This gives as the profit on the manure (£3 10s., less £1 16s. 6d.), £1 13s. 6d. per ton; or, say, £1 10s. per ton.

Sir Joseph Bazalgette estimated a few years since that, roughly speaking, each gallon of sewage-water carries down with it 100 grains of suspended matters, and the daily discharge, Capt. Calver says, is 120,000,000 gallons in dry weather. This would yield 279,225 tons of solid matter per annum, which quantity Capt. Calver thinks too low an estimate. This estimate is, however, considerably higher than would follow from the analyses given by Hofmann and Witt, and by the Rivers' Pollution Commissioners. I do not think that it can be assumed that the organic matter is more than from 50,000 to 55,000 tons per annum, and, if we add to this, for detritus and mineral matter, double its weight, as found in the outfall-sewage by Prof. Williamson, we arrive at only 150,000 or 165,000 tons of solid suspended matters per annum; whereas, with Dr. Letheby's estimate, we should get no more than 116,000 tons, and from the analyses of the Rivers' Pollution Commissioners, and Drs. Hofmann and Witt, only 130,000 tons per annum. Concerning the quantity of solid organic matter in Thames sewage, we may speak with much more confidence, then, of the quantity of the solid mineral matter. Different estimates of the former vary less than 5 per cent.

Taking the lower of the above estimates, so as not to overstate my case—say, 150,000 tons—it may readily be seen from the analyses that we may reasonably hope to effect a rough separation of the deposit. Thus, in a first set of depositing tanks, we should keep back four-fifths of the heavier particles, entangling with them only a small proportion of the organic matter; and, in a further set of tanks, in which the sewage would be brought to complete quiescence, we might recover four-fifths of the organic matter (or 40,000 tons), mixed with half its weight of mineral matter, making a total of 60,000 tons available for the manufacture of a manure.

To this 60,000 tons, we have to add about one-third for the phosphates, &c., mixed with them in the manufacture, giving us, as the total amount of manure, reckoned dry, 80,000 tons, or with the moisture, which we will take at 10 per cent. say, 88,000 tons.

The question of what is to be done with the sand or silt deposit, amounting to 90,000 tons per annum, must also naturally suggest itself. What ought not to be done with it is quite certain; we ought not to cast it into the river. It may be quickly dealt with, and rendered perfectly clean, by passing it through one of Fryer's destructors, heated

with waste cinders, which are now a drug in the market, and most difficult to dispose of; or it might be used for reclaiming a portion of the marshes at the expense of pumping it to some little distance, as was suggested by one of the Royal Commissions, in reference to the whole of the deposit. Surely even this last plan would be preferable to putting it into the river and dredging it out again, and then having it still to dispose of.

If the Metropolitan Board take measures to keep out of the river the whole of the suspended matters which will deposit in tanks of a size moderate, as compared with the total volume of sewage water, they will have done much towards rendering the London sewage practically harmless, as will be readily apparent from the following statements in the reports of various Royal Commissions:—

"The chief part of the nuisance, arising from the discharge of sewage into the rivers and streams, may be obviated by simply arresting the solid matters in the liquid.

"By far the greatest part of the solid matter which is held in suspension in water is readily deposited in rivers, covering the banks with mud, permanently raising the beds, gradually destroying the scouring power and partially silting such rivers up.

"That, however, the appearance of the water may be improved after these deposits have taken place, yet the deposited matters lying in the bed of the current are under conditions favourable to putrefaction, and when the foul mud is disturbed by the prevalence of rain and during floods, it sends forth its effluvia among the populations which are near, and even, in the course of the rivers, far distant."

In short, successive Royal Commissions have repeated the truths told to the Metropolitan Board by their own advisers, Messrs. Bidder, Hawksley, and Bazalgette, in their report on the main drainage. They have further informed them that "covered reservoirs, of moderate size, ought to be constructed near each outlet, for the reception of the sewage water until it shall be discharged during the first hours of the descending tide, or to enable it to be defecated by lime or other chemical agent" (Report, p. 99), "before admission into the river," with a view "to the realisation of its fertilising contents if such should hereafter become commercially valuable." (Report, pp. 98 and 99.)

In the foregoing recommendation then, I have not exceeded that which Sir Joseph Bazalgette himself thought imperative, upwards of 20 years ago, when his main drainage scheme was devised; but in order that the sludge to be used for manure may not be degraded by the mixture with it of a bulky precipitate of carbonate of lime, I have suggested that the coarser mineral suspended matters may first be allowed to deposit in a subsidiary tank, and next that the sewage may be given a period of greater rest in order that the suspended organic matters may separate from the liquid, and be made available for manurial purposes. Finally, I would urge upon the Metropolitan Board the importance of carrying out the recommendation of their present adviser, given when he was acting with the above gentlemen, and I would recommend them to take steps for making the defecation of the sewage perfect by precipitating it with milk of lime. Subsidence alone will not effect the perfection of clarification which the nation might fairly require, if the sewage of London is to be thrown into the noblest river they possess.

If this further treatment be undertaken it gives us another large quantity of worthless matter to be disposed of. For by using 12 grains of lime per gallon, it would, with the carbonate of lime derived from the sewage water, and other matters thrown down, occasion a total deposit of quite 220,000 tons per annum. This I would deal with in one or the other, or all of the following methods:—

Firstly. By adding the proper proportion of clay to be obtained from the river banks with the requisite amount of milk of lime, so as to enable the deposit to be burned into Portland cement, as is now done at Burnley, under much less favourable conditions than would exist under the circumstances I have pointed out.

Secondly. By reburning the precipitate, and using it for a fresh portion of sewage; this operation might be repeated six times, after which the calcined deposit might be used for the manure process, or it might be sold for phosphatic agricultural lime. The phosphoric acid thus recovered would be worth upwards of £20,000 per annum.

Thirdly. By selling the deposit as a top dressing for land, for which purpose farmers might be willing to give for it say 1s. per ton pumped into barges.

I have endeavoured to put my suggestions to you without any exaggeration, and I now commend my estimates and figures to the attention of those interested in this question, and capable of examining into the accuracy of my deductions. The only point on which I myself see any grounds for doubt, is on the question of what proportion of the detritus it is practically possible to separate from the organic matters. To effect such a separation as I have assumed, would not, I submit, be a difficult task for engineers, and the experiment could be made at a trifling expense. The cost of the tanks, if executed in concrete, would probably not exceed £100,000, and as the sale of the manure might be expected to realise £132,000 per annum, it would certainly be sufficient to cover the interest on this sum together with the expense of disposing of the sand.

I trust that the Metropolitan Board of Works will give their careful attention to these figures, and at any rate attempt to keep out of the river all that can be detained, without further taxing the ratepayers of the metropolis. The only reasonable objection that can be urged against my suggestions is that there might be a difficulty in finding a market for so large an amount of manure of a comparatively low standard. If those in authority turn a deaf ear to my arguments, I venture to hope that Parliament will intervene, and no longer bestow upon the Thames the unenviable distinction of being the only filthy river in the country.

DISCUSSION.

Dr. Frankland, F.R.S., thought General Scott had done good service in drawing attention to a grave and continually increasing evil in the Thames, as well to a probable remedy for it. His experience in this matter taught him that the best remedy for a nuisance of this kind was the distribution of sewage on land; but that seemed quite out of the question in the present case. Indeed, the difficulty of acquiring land for such purposes was becoming greater every year; and, therefore, other means of rendering the sewage of towns at least in-

offensive must be resorted to. The chief points raised by the paper were—1. Could the suspended matters be deposited without artificial precipitation; 2. Could they be dried and made into marketable manure without causing a nuisance or losing the valuable ingredients; and 3. What would be the value of the manure, or in other words, the profit or loss attending the process? To the first question he should hesitate to give a decided answer, but he was inclined to think that the entire precipitation of suspended matters without the use of some precipitant could not be effected; at the same time, this imperfect precipitation would be a great gain, as only the lighter particles would gain access to the river; and with proper regulations as to the time of discharge with regard to the tide, they would probably be carried out to sea, without being deposited to any appreciable extent. To the second question he should reply that the collection and drying of deposit from London sewage could only be effected, without considerable nuisance, by the use of some deodoriser, and the choice of an agent was a matter of some difficulty. There were many which could be used, but most of them added considerably to the bulk of inert matter, which was a disadvantage in this case. It was also important that the material employed should be of such a character that its effect would cease after a time, or otherwise it would greatly diminish, if not destroy, the value of the manure, at any rate if the manure material were of an organic character, which depended for its value on undergoing decay. The milk of lime, if it were effectual in the proportion suggested, would not be objectionable from its bulk, but he had some doubt whether the small proportion recommended would be sufficient to prevent putrefaction rapidly setting in. He would suggest, therefore, the feasibility of employing sulphurous acid. On a large scale this was a very cheap disinfectant; it was very effective, and it ceased to be so after a short time, because it became oxidised into sulphuric acid, which was comparatively inert, and rather contributed to the value of the manure than otherwise. Moreover, there were some objections to the use of lime even in small quantities. If the slightest excess were added, the subsequent drying would be attended with the evolution of ammonia, and consequent loss in manurial value. Sulphurous acid would have precisely the opposite effect, as it would retain the ammonia and prevent its being driven off during the drying. On the third point, which was perhaps the most important of all, General Scott had, as far as his experience went, somewhat overrated the value of this material as a manure. His experience was, that after the separation of the detritus from London sewage, the maximum per-centage of organic matter was 63, whilst the minimum was 21, the average being 39½; and these high per-centages were obtained under exceptionally favourable circumstances, because, in the collection of these samples of sewage, little or none of the so-called detritus was mixed with it at all; it was to some extent a settled sewage, whilst the suspended matter was obtained by the most perfect process known to chemists, viz., by filtration through paper, by which almost every trace was retained. Under these circumstances, therefore, the mineral detritus was wanting, and there was a greater proportion of organic matter than could be obtained by the simple process of subsidence in tanks. He did not think, therefore, it would be safe to calculate on more than 33 per cent. of organic matter in the dried sludge, which would much reduce the value of the manure, for the value of a manure diminished in an accelerated rate as its strength was reduced. He did not quite understand some of the figures, but it appeared that £3 16s. 6d. a ton was put down for the nitrogen of the organic matter, which, if his estimates were correct, would have to be reduced to £1 18s. 3d., and this would obviously necessitate a great reduction in the amount of superphosphate of lime to be added, in order to bring up the proportion of phosphate of lime to nitrogen as four to one, thus again diminishing the value of the manure. However, these economical considerations ought not to have too much weight. The Board of Works had no right to look for a profit in getting rid of the objectionable matter. If they could succeed in doing it without a loss, or at a cost not greater than that involved in dredging it out of the river again, it ought to be done; because, if sewage mud were deposited in the river, there must be an obstruction to navigation, besides the putrefaction of organic matters, which, when deposited on the banks of a tidal estuary, became very offensive, especially in warm weather. On the whole, therefore, he thought General Scott's process was worthy of trial on a sufficiently extensive scale, and a want of profit ought not to be deemed evidence of failure.

Dr. Voelcker, F.R.S., said, whatsoever might be the opinion as to the best means of getting the suspended matter, which was the chief source of nuisance in London sewage, deposited, or with regard to the value of manure which might be ultimately produced, there could be no two opinions on one point—that the sewage ought to be kept out of the river; and he most cordially agreed with General Scott's conclusion that pressure ought to be put on the Government to do something towards the effectual purification of the Thames. His only surprise was, how it could be doubted that sewage matter accumulated in the river. He had gone very carefully into the figures in the paper, and was very glad to find that General Scott had avoided those exaggerations which frequently disfigured calculations of this kind. Not that he agreed with him in every particular, but on the whole, he had given his estimates very fairly. There was one matter, however, which he had not touched, and that was the expense incurred in drying sewage sludge so as to prepare manure. From a number of experiments he (Dr. Voelcker) had made, he found that sewage sludge, after it had been thoroughly drained for 48 hours, contained over 80 per cent. of water; after three or four days it contained 75¾ per cent.; after five days 72 per cent., and after eight days of rest lost little more. It was quite true that with the admixture of porous substances, like precipitated phosphate of lime, it would dry with greater rapidity, but still, without artificial heat it was impossible to so dry it as to bring it into a marketable condition; and he was afraid that the expense of effecting a thorough desiccation of the sewage sludge manure, although it might be mixed with precipitated phosphate of lime, would swallow up more than the whole amount of the profit shown in the paper. Another difficulty had been alluded to, viz., the disposal of large quantities of manure of a low standard of fertility. This manure would probably have to be sold at something like £3 per ton, when allowance was made for the diminished quantity of nitrogen, which he believed would be necessary; for he knew, from the composition of sewage sludge—not as it ought to be, but as it was—that that reduction would have to be made; and to dispose of 80,000 tons of such manure within a reasonable circuit was not a very easy matter. Still, some attempt should be made to follow out the suggestion which General Scott had made, and if it were deemed advisable to mix the precipitated phosphate with the sewage mud, he would suggest that great economy might be effected by the establishment of acid works on the spot, because in the use of brown acid an expense was necessarily incurred in the evaporation of the chamber acid, which was altogether unnecessary, inasmuch as the acid had afterwards to be diluted again with water, and the chief expense in the manufacture of brown acid lay in the concentration of the liquid. Therefore, if you could save that expense, you would materially reduce the cost of superphosphate. Again, you might use materials which, at present, had very little value, and were, indeed, unsaleable; low kinds of phosphate,

such as some of the French and Belgian deposits. Some of the Boulogne coprolites did not contain more than 40 per cent. of phosphate of lime, and there were others which contained a good deal of phosphate of iron, and also deposits of phosphate of alumina, which, at present, were altogether unsaleable. If these were dissolved on the spot in diluted sulphuric acid, they might be utilised for effecting the partial precipitation required, and facilitating the manufacture of more or less valuable manure: but, on the whole, his own impression was that perhaps the most economical and practical plan of dealing with sewage mud would be to pump it on to marsh land, if such were available, and to dig it in then and there. He believed there was no such deodoriser as earth, and from some experience at Birmingham he knew that immense quantities of sewage sludge may be got rid of in this easy and simple way at once, and by means of the tract of land surrounding, in a large populous place like London, might be made into garden ground and utilised for growing vegetable produce.

Mr. F. J. Bramwell, F.R.S., asked if there were not proceedings in Chancery to stop the sludge being deposited near Birmingham?

Dr. Voelcker said that was at a time when it was accumulated by the Corporation in the hope that some good-hearted agriculturalist would buy it. It was found, however, that they would not even have it as a gift, and thus it accumulated to a depth from 3 ft. to 5 ft. When the injunction was brought against the Corporation, they were obliged to do something with it, and at his suggestion, they dug it in and thus disposed of it.

Mr. Bramwell asked if the prices put down in the paper for ammonia were not the prices it was worth if it were found walking about detached from its friends. In other words, did it not involve a certain fallacy, viz., that if you had so much material in a compound, that in itself was worth something, therefore the compound which contained that material was worth almost a proportionate amount? He would give an illustration. Suppose the iron in ordinary brick earth were 2 per cent., there would be about 45 lbs. weight per ton, which would be worth about 1s., and therefore it might be said that every ton of brick earth contained 1s. worth of iron. This would be true if the iron were separate, but was it true when it was mixed with the other materials? Similarly, he wanted to know whether in the prices named, sufficient account had been taken of the facts that the valuable matters were associated with a very large amount of inert matter.

Mr. Baldwin Latham, C.E., thought this question must not be resolved into one of making a profit or loss. He had had considerable experience in drying sludge, and had, unfortunately, lost a very large sum of money in trying to make a profitable manure from sewage. There was no known process which had not come under his observation, and it had invariably been found that the cost of precipitation, drying, and production, and the difficulty of disposing of the manure afterwards, for there being a great prejudice against it in the agricultural mind, entirely prevented any profit being made. No doubt there was a certain amount of value in each manure, but it was extremely difficult to realise it in practice. Birmingham had been under his observation recently. He had received analyses of two samples of sewage sludge, with the value attached, made by Dr. Wallace, Medical Officer of Health for Glasgow. At Birmingham there were two sets of tanks; the tanks in which the detritus was deposited, after which the sewage flowed through sixteen other tanks, which contained the finer deposits. Fourteen tons of lime were every day added to the sewage at about a quarter of a mile from the sewers. The population which contributed to these tanks was 45,000, and the quantity of sewage extracted per day was 500 tons. Now, as the Birmingham sewage district contained about one-tenth of the population of the metropolis, it would follow that there would be 5,000 tons produced per day in London. The greatest part of this sludge was water. It varied at different periods of the year. One sample, taken in August, showed 415 per cent. of water compared with the dry matter in the sewage itself, whilst a recent sample, taken on the 11th November, showed 600 per cent. of water, so that in the latter case six tons of water had to be got rid of to produce one ton of dry matter. This sludge was elevated by steam power to a series of high shoots, when it was distributed over the land, which was divided into a number of small plots. In the course of a fortnight or three weeks, a large portion of the water had drained away, the land being very porous, and the sludge in that state was found to contain 90 per cent. of water compared with the dry matter, in August, whilst this month it contained 117 per cent.; so that even in the dry state in which it was dug into the land there was as much water as dry matter. Here, again, came the difficulty of dealing with these manures if artificial heat had to be applied, having regard to the small value of the resulting manure, which at Birmingham was worth 11s. 5d. per ton. It was utterly impossible for it to pay anyone, therefore, to embark money with the idea of making a profitable manure out of London sewage. On the other hand, this was a question which ought to be approached by the governing body of this great city, and it was a disgrace to the age that the sewage in its raw state should be thrust into the river. There were ways, as Birmingham had shown, by which precipitation might be effected, and if there were not a sale for the manure, there were acres and acres of low land abutting on the Thames which could be treated in this way, and thus, year by year, improved in value. Although Birmingham lost by dealing with its sewage in this way, when the sludge was applied to the land, taking the land at its original agricultural rent last year, it showed a profit on the 272 acres of £850. He did not, therefore, see any insuperable difficulty in the way of sewage sludge being brought into a state in which it could be thrown into the river.

The following letter from Mr. Mechi was read by the **Secretary**:—

Tiptree-hall, Kelvedon,
November 25, 1879.

Dear Sir,—Not being able to be present, permit me to send a few words about sewage. The late Baron Liebig stated expressly that the addition of phosphates with town sewage would be advantageous, seeing that the bones of birds, fish, and animals were withdrawn and not consumed, and so did not enter the sewers.

With regard to the general sewage question, I have, personally arrived at the conclusion that the rain and land water should pass away separately from the sewage, and that the most advantageous mode of transmitting the latter, "with the greatest effect and at the least cost," would be by the use of Mr. Isaac Shone's admirable system of pneumatic ejectors, thus ensuring a rapid transit, regardless of ultimate fall or level.

No doubt, agriculture would quickly avail itself of the sewage when separated from the rain-fall.—I have the honour to be, your obedient servant,

J. J. Mechi.

Mr. Cresswell said he was not going to play the part of "profligate associate," attributed in the paper to the detritus in sewage, by attempting to diminish the great value of the information already given to the meeting on the scientific part of the question, but would merely make a few remarks on a matter which they all acknowledged to be of vital importance to the well-being of the metropolis. On the 16th May, he read a

paper in that room which led to a resolution being passed unanimously that the Council of the Society, in connection with various illustrious men, should form a deputation to the Government, calling its attention to the increased and ever increasing pollution of the Thames, and he hoped, now that the session had commenced, this resolution would not be lost sight of. On that occasion they had the advantage of hearing an authority on the subject of the Thames pollution, and the treatment of sewage, in the person of Captain Douglas Galton, who made certain suggestions, and gave a history of his own action in the matter. He said, amongst other things, that he was not in favour of a system of clarification, which, he thought, might be too costly, and rather preferred the carrying out of a suggestion which he, as colleague of Messrs. Simpson and Blackwell, made many years ago, that instead of carrying the sewage of London down to Woolwich, it should be carried down to Sea Reach, below Gravesend. Now, he was of opinion that they calculated the cost too narrowly in this matter. Nothing in the world could be done without cost. They had it on the authority of Professor Tyndall, that every passing thought in the brain was a question of cost; it was part of the wear and tear of our existence. So that if you decided against any plan simply on the question of cost, everything would be stopped. It was a question rather of comparative cost, and whatever might be the cost of the plan suggested by General Scott, improved upon as it had been by Dr. Voelcker, nothing could be more costly to the well-being of the metropolis than to go on as they were at present. The question therefore was, what should be done, and he would throw out a suggestion which had occurred to him that morning, and which had been partly anticipated by Dr. Voelcker and Mr. Latham. Assuming Captain Galton to be right, and that it was under any circumstances wise to take the sewage farther down the river, they would find that in that locality the northern banks of the Thames consisted of marsh land, in many parts comparatively useless; and he would suggest that the sewage of London, certainly of the northern portion, should be carried down to some such point, that it should be there defecated by any process which chemical science could suggest, so as to avoid the difficulty which Mr. Bramwell anticipated from an enormous mass of sewage matter being deposited anywhere, liable to putrefaction if the deodorising agent had ceased to have any effect. When there defecated, it should be pumped over the marshes, so as to form an alluvium; thus doing, by an artificial process, that which Nature had done in many parts of the world. He had seen a great deal of Holland, the greater part of which consisted of alluvial deposits, which were caused by the natural subsidence of the waters of the Rhine carried down in the course of ages. The same thing occurred in the delta of the Nile; and the wheat-growing lands of the Danube were almost exclusively created by the subsidence of matter brought down by floods, in which the organic matter was about 50 per cent. They would thus be reproducing, in the course of time, a sort of new Holland on a part of our coast, where garden-ground and wheat-growing land would be particularly valuable. It was suggested some years ago, when the Essex Reclamation Company proposed to deal with the sewage of London, that it should be carried down to the Maplin Sands; but a great chemist (Prof. Liebig) raised a grave objection, on the ground that the sand at Maplin was absolutely unfertilisable, and that no amount of sewage put upon it would ever make it productive. That would not apply to the marshes near the Thames; and assuming that this idea would bear discussion, it seemed to be worth while to entertain it, for the simple reason, that by carrying the sewage further down from London, you would certainly prevent an accumulation of deposit At the same time, it suggested a method of utilising that which was at present of no value, and saving us from the terrible dilemma in which we were now placed, of polluting the river, obstructing the highways of commerce, and seriously endangering, if not altogether sacrificing, the interests of many of the towns upon the river below Woolwich, to the selfish convenience of the metropolis.

Dr. Bartlett wished to call attention to the fact that the amount of detritus in the sewage carried down to the present outfalls, was plainly described by General Scott, and admitted by everyone to be the larger portion of that which rendered the sewage of so little value. He was of opinion, from a large number of analyses he had made, that this detritus was much larger in proportion than had even been stated by General Scott, or anyone who had yet spoken; and he had no doubt that the greater part of the matter which had been found in the Thames as an obstruction was mainly composed of this detritus. On the other hand, he had been informed by one of the chemists engaged in the investigation, that those who had submitted their results, to enable the Metropolitan Board of Works to form an opinion as to the amount of objectionable organic matter to be found in those deposits, had employed the following method of analysis. They had collected, in a very perfunctory manner, sundry samples—more than 200—at various points, of water and sludge. They had dried this, and burned off the residue, and he believed they had been unwise enough to consider that the amount so burned off represented the organic matter present. Every chemist would at once perceive that in this way they had only arrived at a fallacy. In this process they had lost the whole of the water of crystallisation, and a large number of volatile matters, which were not to be deemed organic contamination; and in so dealing with the matter they had only given their clients information which must be fatal to them when they attempted to show that they had not contaminated the river. It was impossible to believe that putrefying organic matter lay at the bottom of the river for any great length of time; and, on the other hand, it was perfectly obvious that the amount of injury which had accrued to health was one of those matters which could be estimated by the offence to the nose, which had been evident to almost everybody. General Scott, then, had made out a strong case for keeping, to the largest possible extent, all these matters out of any part of the river where they could come back to the inhabitants. He might not, perhaps, have taken the wisest course in making his estimates as regards economy of dealing with it; but, even allowing a large margin, he had shown a very good case for dealing with the sewage in some other way than turning it into the river so near London. If we were unable to obtain any better evidence than we at present had, it called for further inquiry, on the part both of chemists and engineers, to let us have something which could be relied on, first to show what the sewage really was, and secondly, how it could be disposed of. He believed that at present there were really no trustworthy data as to the composition of the sewage.

Mr. Tracy remarked that he had heard Sir Joseph Bazalgette say in that very room that engineers could make any amount of culverts, but the question was whether they would be of any use when they were made. He contended that a great part of the manurial value of the sewage escaped from the sewers, in the shape of foul gases, which polluted the air; and thought they had done wrong in going to the men of bricks and mortar, instead of to those who really understood the nature of the problem to be solved.

Mr. W. Paul said he had had for many years a strong belief in the value of sewage as manure, and had conducted a long series of careful experiments on the subject, employing mainly roses and geraniums, which must be taken as types of slow-growing and quick-growing

plants. The results might be shortly stated thus. If the growth of unmanured plants were taken as 1, that of those treated with unclarified sewage would be represented by 1½, and of those treated with clarified sewage by 2. This would give a rough but practical idea of the value of sewage in favouring the growth of plants.

The Chairman having moved a cordial vote of thanks to Major-General Scott, which was carried unanimously,

Major-General Scott, in reply, said Dr. Frankland had remarked on three points in the paper which he considered to be defects. First, the imperfect separation of the solid matters which would take place by subsidence merely; second, the possibility of an injurious excess of lime; and thirdly, the estimate he had given of the amount of organic matter. The first point must, of course, be conceded. With reference to the second, he only allowed such an excess as enabled him to preserve the phosphoric acid, but it would be quite possible, when all the water had drained off so far as it would, to rake in a sufficient quantity of sulphuric acid to give it acidity, if, as Dr. Voelcker suggested, it lost any nitrogen by drying it with lime. With reference to the third point, he held he was not mistaken in saying that in the table of which he had made so much use, the examination of the metropolitan sewages (chiefly by Dr. Frankland), the amount of organic matter found was in the proportion of nearly ⅔, whereas he had only put it as ½ to ⅔ of detritus. He had made a long series of experiments at Ealing, and there he found the proportion was ⅔ organic matter to ⅓ of mineral matter. Another of the tables showed also that the organic matter was twice the amount of the mineral. Dr. Voelcker had spoken of the great difficulty and expense of drying the sludge, which everybody who had had any experience in the matter was aware of. He had had a great deal of experience, and he believed he had allowed enough; but every day the machines for drying this sort of material were being improved. He had already spoken of the loss of nitrogen, but Dr. Frankland and Dr. Voelcker had shown how the process might be improved by using sulphurous acid, and by making the sulphuric acid on the spot. Mr. Bramwell had raised a difficulty about too great a value being put on the fertilising material, but it was allowed that if nitrogen were worth £80 a ton, and phosphoric acid £10 a ton, a manure at £8 a ton would afford the full theoretical value given to it. Mr. Baldwin Latham had referred to Birmingham, but it must be borne in mind that that was not to any great extent a water-closeted town. He also spoke of the precipitation of the organic matter by lime, which he did not propose to do. He should allow it to subside in the first tank without any precipitant. He also referred to the question of profit; but that was not his position at all. It was a very different thing for the Metropolitan Board to do it because they had to do it, and for a company to go into it with an idea of profit. As it was getting late, he would not detain the meeting any longer, except to return his thanks for the kind attention with which his remarks had been received.

MISCELLANEOUS.

ENGLISH STRAW PLAIT MANUFACTURE.

Although the manufacture of straw hats was introduced into England by James I, and took root at that time in Bedfordshire, the large size of the wheat-straw used for plaiting prevented the home manufacture from entering into successful competition with the finer productions of Italy.

The founders of the Society of Arts endeavoured, by the offer of rewards, to stimulate and improve the British material. The difficulty caused by the size of the straw was partly overcome by splitting it, and in the year 1774, a reward of thirty guineas was given to Mr. John Pepperell, for having established a manufactory of chip hats at Totnes. In 1775, five guineas were awarded to Mr. Robert Galloway, for the invention of tools for cutting chip hats. Ten guineas additional were given to Mr. Pepperell for the chip hats made at his manufactory at Totnes.

In 1804, the Society's gold medal was voted to Mr. William Corston for a substitution of a plait from rye straw, which he had introduced in place of Leghorn plait. Six years' afterwards, Mr. Corston wrote to the Society an account of his experiments in growing the grass on Bagshot-heath and on some barren land in Norfolk, in which paper he claimed that his manufacture had then obtained an established success.*

A strong interest was still felt in the improvement of the home production, as it was found that, after the re-establishment of peace in 1815, the British producers were unable to compete with the Italian straw bonnets, which were largely imported, in spite of the heavy protecting duty imposed upon them by the Government. Mr. J. Parry received the Society's silver medal for the manufacture of Leghorn plait from straw imported from Italy; and in the same year, Miss Sophia Woodhouse, a farmer's daughter, of Weathersfield, in Connecticut (afterwards Mrs. Wells), sent to the Society an imitation Leghorn bonnet of her own manufacture, from the stems of a species of grass growing spontaneously in that part of the United States, and popularly known by the name of *Ticklemoth*. This communication† met with great approval, and some of the principal dealers in such articles, after inspecting the bonnet, declared that it was superior even to Leghorn in the fineness of the material and beauty of its colour. In accordance with this expression of opinion, the large silver medal and twenty guineas were awarded to Mrs. Wells. William Cobbett was much struck with the importance of this subject, and printed an account of it in his *Register*. An importer of Italian straw then applied to Cobbett to know whether he could get any of the American straw imported. The result was that Cobbett set to work in his usual energetic manner to see if English grasses might not be used for the same purpose, and he thus opened up a fresh industry for large numbers of the unemployed. The Society did not allow this action to pass without notice, and we therefore find in the List of Premiums for 1823 the following entry:—"To Mr. W. Cobbett, Kensington, for plat from English grass, *the large silver medal*." Mr. Edward Smith, the biographer of Cobbett, notices this matter, and points out that, as his subject was at this time looked upon by many as a dangerous character, the newspapers announced the award with the heading, "The Society of Arts humbugged at last."

QUALITY OF THE PAPER EMPLOYED BY THE DAILY PRESS.‡

Some two years since I had occasion to inquire into the quality of the paper supplied to a well-known daily paper, and I then incidently examined the paper employed for various prominent newspapers, with the aim of ascertaining whether the paper in question was better or worse than the generality.

The plan of inquiry adopted was a very simple one. A strip of paper one inch wide and twelve inches long was cut from the edge of the newspaper. It was then well dried in a water-oven, and its weight taken. This was calculated to the square foot of paper. The strip of paper was then burnt, and the ash weighed. This

* "Transactions of the Society of Arts," vol. 28 (1811), p. 130.
† "Transactions," vol. 40, p. 217.
‡Paper by A. H. Allen, read before the Society of Public Analysts, at Sheffield, on August 22, 1879.

weight was calculated to a per-centage of the weight of the original strip.

The following table shows the results yielded by the leading daily papers. The papers are arranged in the order of their quality, as measured by the weight of the paper less that of the ash. This plan gives an approximation to the amount of the fibre, but of course the results are nothing more than rough comparisons, as the quality of the paper is liable to accidental variation from several causes:—

Name of Paper.	Weight of Paper in grs. per square foot.		Percentage of Ash.
	Total Weight	Exclusive of Ash.	
Morning Post	110·4	104·1	5·7
Times	90·5	77·7	14·1
Pall Mall Gazette	94·2	76·8	18·4
Birmingham Daily Post	82·2	75·1	8·6
Daily Telegraph	71·1	66·5	6·4
Plymouth Post	68·8	65·2	5·4
Sheffield Daily Telegraph	71·3	63·0	11·5
Bristol Daily Post	67·7	62·5	7·6
Daily News	67·7	61·0	10·0
Western Morning News	68·7	61·0	11·4
Standard	71·1	60·2	15·3
Globe	69·8	59·1	14·2
York Herald	65·5	58·5	10·8
Manchester Guardian	64·1	58·2	9·2
Leeds Mercury	63·7	57·3	10·1
Manchester Examiner	67·7	56·4	12·9
Liverpool Daily Post	59·3	56·2	5·1
Echo	68·7	56·0	18·3
Yorkshire Post	64·2	54·4	15·4
Liverpool Mercury	60·8	53·3	12·3
Sheffield Independent	62·5	51·7	17·4
Western Daily Press	58·3	50·1	14·0

These results clearly show, as might have been expected, that the *Morning Post* and *Times* papers are heavier and stronger than those employed for the penny press. The difference between the ash of these two papers is, however, somewhat striking, and other curious points will occur to anyone inspecting the figures.

The weight and percentage of ash of paper furnish the usual commercial tests of quality, and although these factors are not the only ones which should be taken into account in forming an opinion, they are of considerable importance, and hence the figures recorded may be of service to chemists engaged on similar inquiries, as they show what newspapers should contain. Other things being equal, the paper will be better the greater its weight per square foot. The ash, of course, indicates so much mineral matter added to give weight, substance, and surface; and, as it does not add to the strength, it should be deducted before making a comparison of the quality.

I may add that the colouring matter which gives the *Globe* its roseate hue is aniline red. It may readily be dissolved out of the paper by alcohol.

GENERAL NOTES.

Ozokerite.—A large deposit of ozokerite, 20 miles long and 20 feet thick, says the *Telegraphic Journal*, has been discovered in Utah territory, U.S. It is harder than the ordinary ozokerite; but its insulating properties has not, it is believed, been tested as yet. The production of ozokerite oil in the Eastern Galicia oil fields is very limited in amount at present. The wells are mostly situated near Boryslaw, though there is one well south of Boryslaw about 45 miles, that is producing 8 to 10 barrels per day of nice green oil. The wax fields of Eastern Galicia attract the most attention. This earth wax, or ozokerite, as it is called, is neither more nor less than oil that has been evaporated, leaving the residuum in a solid state, so that it is dug out with picks and shovels, and is about the consistency of common clay. It is very valuable, being worth from 7 to 8 cents. per pound. The shafts are from 350 to 600 feet deep and very close together, so close that, on the piece of land where this wax is found at Boryslaw, containing not over 50 acres, there are 10,000 shafts. The walls of these shafts are curbed with timbers, but at the depth to which they go they are very thin, so that scarcely a day passes but the walls cave in, breaking the timbers like pipe stems, and burying several human beings beneath the great mass of earth. This thing occurs so frequently, that from four to six persons per week are killed in this manner. Great fortunes have been accumulated by a few of the Jews who owned the land where the wax was found. The vein is about 16 inches thick, and the wax is carried out in buckets. Twelve thousand men live on that 50 acres of land, how, nobody knows. The wax is refined and made into candles; and, being an excellent insulator, also into condensers for electrical purposes.

Trees in Towns.—At the Social Science Congress, Manchester, Dr. Phené read a paper "On the Sanitary Results of Planting Trees in Towns." He said that, during repeated visits to the Continent, he had directed his attention to the apparent difference of health of urban populations, in those parts where trees grew, and where they did not, and had always found those persons living in the vicinity of trees looking more healthy than their neighbours. He had closely observed what trees grew best in such confined spaces, and began his experiments in England as far back as 1850, by planting several streets in the style of the French boulevards, in a neighbourhood which, though at a low level, was shown originally to have been quite healthy, but in which a number of small houses had for a long time back been erected, and in which houses fever and diseases of various kinds were frequent. The streets were in different positions, *i.e.*, from north to south and east to west. The result of his experience was, that quite independently of the condition of ill-health which often prevailed in some of the neighbouring districts, from which the occupants of these planted streets were free, the same thing applied to periods of epidemics, when the large and wealthy neighbourhoods around, but further removed, were also seriously affected. He did not, of course, attribute the whole of the difference to the trees. He had exerted care in drainage and other sanitary improvements with, of course, beneficial results, but, on the one hand, the levels, subsoil, and exact position were shared by a large number of inhabitants other than those on the estate in question, and all the sanitary appliances and advantages were enjoyed by the wealthier neighbourhoods, and yet during thirty years he had not been able to trace a single case of fever or small-pox in any of the streets so planted, even when the epidemics were most serious around him, including districts occupied by the wealthy classes. Dr. Phené then described the latest scientific experiments on the oxygenating property of trees, from which most beneficial results were manifest, and from which it was evident that the presence of fresh green foliage was a prime condition in the health of a dense urban population. The following is a list of the trees which, from experiments extending over thirty years, he has found grow in London, some of the most beautiful being those which grow with great rapidity and little attention. Acer pseudo-platanus; Ailanthus glandulosa; Catalpa syringifolia; Fraximus Europea; Gleditschia; Populus alba; Populus nigra; Populus Canadensis; Quercus cerris; Rhus typhinum; Robinia pseud-acacia; Tilia; Ulmus campestris; also the common ash, oak, elm, pink chestnut, copper beech (a fine specimen of which is in the rectory gardens, Chelsea), mulberry, thorn,—white and red; common and Oriental planes; and of shrubs, Ilex ovata, and other hollies; lilac, common and Persian; Euonymus, various; almond and wild plum, privet, aucuba, &c.

Musical Examinations.—The *Athenæum*, in noticing the report of the Musical Committee of the Society of Arts, remarks that "it is to be hoped that the matter will be so forcibly placed before the Government as to induce them to insist that the teaching of music shall hereafter be a reality and not a farce."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

The following arrangements for the Wednesday evenings before Christmas have been made:—

December 3.—"Apprenticeship: Scientific and Unscientific." By Silvanus P. Thompson, B.A., D.Sc., Professor of Experimental Physics at University College, Bristol. Prof. Huxley, F.R.S., will preside.

December 10.—"Art Vestiges in Afghanistan; the Result of Some Recent Explorations in the Jellalabad Valley." By William Simpson. Sir J. Douglas Forsyth, K.C.S.I., will preside.

December 17.—"The Panama Canal." By Captain Bedford Pim, R.N., M.P.

At the meetings after Christmas the following papers, amongst others, will be read:—

"Domestic Poisons." By Henry Carr.
"Gas Furnaces and Kilns for Burning Pottery." By Herbert Guthrie, C.E.
"The Utilisation of Slag." By Charles Wood.
"Art in Japan." By C. Pfoundes.
"The Trade and Commerce of the Yenisei." By Henry Seebohm.
"Modern Autographic Printing Processes." By Thomas Bolas, F.C.S.
"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.
"Art Ironwork." By J. W. Singer.
"The History of Musical Pitch." By A. J. Ellis, F.R.S.
"The Recent History of Explosive Agents." By Prof. F. A. Abel, C.B., F.R.S.
"Iceland and its Resources." By C. G. W. Lock.
"The Future of Epping Forest." By William Paul, F.L.S.

Cantor Lectures.

Monday evenings, at Eight o'clock.

The First Course, on "The Chemistry of Bread and Bread-making," five lectures, by Dr. Charles Graham, F.C.S., F.I.C., Professor of Chemical Technology at University College, London.

Lecture II.—December 1.

Continuation of the examination of starch and its hydration products. The albuminous matter of flour, soluble and insoluble.

Lecture III.—December 8.

Action of albuminoids. Rationale of kiln drying. Flour making. The dough. Action of moisture, heat, and albuminoids on starch.

Lecture IV.—December 15.

Fermentation. Leaven. Yeast. Ferments of disease. Changes produced. The use of the microscope in the examination of yeast.

Lecture V.—December 22.

Baking; changes produced by heat. Aërated breads; foreign breads; biscuits, &c. Digestion of bread a continuance of fermentation; conditions requisite. Conclusion.

The Second Course will be on the "Manufacture of India-rubber and Gutta-percha," by Mr. Thomas Bolas, F.C.S. It will consist of six lectures, to be given on the following dates:—Feb. 2, 9, 16, 23; March 1, 8.

The Third Course will be by Mr. R. W. Edis, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 1st...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Charles Graham, "The Chemistry of Bread and Bread-making." (Lecture II.)
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Henry Robinson, "Sewage Disposal."
British Architects, 9, Conduit-street, W., 8 p.m. Opening Address of the Session, by the President, Mr. John Whichcord.
Medical, 11, Chandos-street, W., 8½ p.m.
Royal, Burlington-house, W., 4 p.m. Annual Meeting. Election of Fellows.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Prof. Noah Porter, "Physiological Metaphysics."
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Huxley, "Snakes."
Tuesday, Dec. 2nd...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. W. Carson, "Passenger Steamers of the Thames, the Mersey, and the Clyde."
Pathological, 53, Berners-street, Oxford-street, W., 8¼ p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Wednesday, Dec. 3rd...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. Prof. Silvanus P. Thompson, "Apprenticeship: Scientific and Unscientific."
Geological, Burlington-house, W., 8 p.m. 1. Dr. C. Callaway, "The Gneissic and Granitoid Rocks of Anglesey and the Malvern Hills," with an Appendix by Prof. T. G. Bonney. 2. Prof. T. G. Bonney, "Petrological Notes on the Vicinity of the Upper Part of Loch Maree." 3. Mr. P. Herbert Carpenter, "Some Undescribed *Comatulæ* from the British Secondary Rocks."
Entomological, 11, Chandos-street, W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Dr. Paul will call attention to, and exhibit, Standards to be used in verifying the Apothecaries Weights and Measures used in trade. 2. Mr. H. Collier, "Tincture of Senega as an Emulsifying Agent." 3. Mr. W. H. Naylor, "A Method for the Volumetric Estimation of Arsenic Acid."
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. C. W. Dymond, "The Trethevy Stone, Cornwall." 2. Mr. Thomas Morgan, "Results of the Great Yarmouth Congress" (conclusion).
Obstetrical, 53, Berners-street, W., 8 p.m.
Society for the Development of the Science of Education, Memorial-hall, Farringdon-street, E.C., 7½ p.m. Rev. E. White, "Moral Education."
Thursday, Dec. 4th...Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Prof. P. M. Duncan, "A Synthetic Form of Ophiurid from the N. Atlantic." 2. Mr. C. B. Clarke, "Indian Begonias."
Chemical, Burlington-house, W., 8 p.m. 1. Mr. F. D. Brown, "The Theory of Fractional Distillation." (Part II.) 2. Messrs. M. M. P. Muir and Charles Slater, "The Influence exerted upon certain chemical changes by variations in the amount of water of dilution." 3. Dr. Japp, "A and B Phenanthrene Carbonic Acid." 4. Dr. P. Phillips Bedson, "Some Derivatives of Phenyl Acetic Acid."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. W. Crookes, "Experimental Demonstrations of Recent Researches in Radiant Matter."
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
Friday Dec. 5th...Geologists' Association, University College, W.C., 8 p.m. Mr. Andrew Taylor, "The Origin and Petrology (specially of South Side) of Salisbury Crags, Edinburgh."
Philological, University College, W.C., 8. p.m. Mr. Henry Sweet, "History of English Sounds and Dialects." (Part I.)
Municipal and Sanitary Engineers and Surveyors, in the new Pumping Station, at Merton, Surrey, 11½ a.m. 1. Mr. James Craggs, "Junction Blocks, their use and advantages." 2. Mr. W. Santo Crimp, "The Sewerage Works of the Croydon Rural Sanitary Authority." 3. Mr. Graham Smith, "Notes on Ironwork." The various sewerage works in course of construction for the Croydon Rural Sanitary Authority will be then inspected.
Saturday, Dec. 6th...Trade Guilds of Learning and Social Education League (at the House of the Society of Arts), 8 p.m. Free Lecture.

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FRIDAY, DECEMBER 5, 1879.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

FOREIGN AND COLONIAL SECTION COMMITTEE.

A meeting of this Committee was held on Wednesday, the 26th ult., to arrange for the proceedings of the Section during the coming session. Present:—Sir Rutherford Alcock, K.C.B. (in the chair), Mr. Hyde Clarke, Mr. E. Hutchinson, Mr. C. Pfoundes, Mr. Trelawny Saunders, and Mr. Frederick Young, with Mr. H. Trueman Wood, secretary, and Dr. R. J. Mann, secretary to the Section.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. W. H. PREECE, on "Recent Wonders of Sound" and "Recent Wonders of Light." The dates for the lectures will be Friday, the 2nd, and Friday, the 9th of January next. The lectures will commence at seven o'clock. As the number of seats is limited, admission will be by ticket only, and when sufficient tickets have been issued to fill the Room, the issue will be discontinued. The tickets will be supplied strictly in the order in which applications are received. Subject to these conditions, each member is entitled to a ticket admitting two children and one adult. The tickets are now being issued, and members requiring them are requested to make application to the Secretary at once.

NATIONAL TRAINING SCHOOL FOR MUSIC.

In consequence of the numerous applications from the public for admission, the Committee of Management of the National Training School for Music have made arrangements to receive private pupils for periods of not less than one year, on the payment of fees. Such pupils will be required:—

1. To pass a test examination to the satisfaction of the principal or of the Board of Professors.

2. To furnish the authorities of the school with certificates of birth and health, and with testimonials from persons of good repute as to moral character.

3. To pay, in advance, to the bankers of the school, Messrs. Coutts & Co., Strand, the sum of £40 per annum.

4. To sign an agreement to observe all the rules of the school, and to work out the curriculum of studies appointed by the authorities of the school.

Applications and inquiries should be addressed to the Registrar, National Training School for Music, Kensington-gore, S.W.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, December 3rd, 1879; Professor THOMAS H. HUXLEY, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Ball, James, 3, Clarence-terrace, Avondale-road, Peckham, S.E.
Berry, Edward E., 27, Upper Bedford-place, W.C.
Bird, Alexander Frederick Samuel, Alderman, J.P., Mayor of Deal, 118, Beach-street, Deal, Kent.
Hunt, John Mortimer, 156, New Bond-street, W.
Le Cren, Henry John, 107, St. George's-square, S.W.
Neate, John, 53, Belsize-park, Hampstead, N.W.
Stewart, Robert, Mimosadale, Lordship-lane, East Dulwich, S.E.
Wilton, Francis, C.E., Lichfield-house, Lawrie-park, Sydenham, S.E.

And as Honorary Corresponding Member:—
Merino, Señor Don Ramon, General Post-office, Havana.

The following candidates were balloted for and duly elected members of the Society:—

Addis, William Judson, C.E., Prome, British Burmah.
Baillie, Captain Alexander, 19, Victoria-street, Westminster, S.W.
Boucherville, Boucher de, Quebec.
Bradshaw, James, 100, King-street, Manchester.
Braithwaite, Stephen Nelson, 25, Throgmorton-street, E.C.
Britten, Lieut.-Colonel John, 24, Ledbury-road, Bayswater, W.
Cavanagh, General, Long Ditton, Surrey.
Coiffier, Louis Alexandre Claris, 13, Hatton-garden, E.C.
Coop, Timothy, Bethany, Southport.
Covert, John Russell, 89, Chancery-lane, W.C.
Croger, Thomas Rodolphus, 37, Wood-street, E.C., and Lindon-villa, Ashby-road, Canonbury, N.
De Renzy, Deputy-Surgeon-General A.C.E., Shillong, India.
Deverell, W. T., 6, Blenheim-road, St. John's-wood, N.W.
Ditcham, William Vooght, D.D.S., 3, Belle Vue-place, Upper Clapton, E.
Duncan, Major Francis, R.A., M.A., LL.D., 29, The Common, Woolwich, S.E.
Eames, Mark, 40, Sclater-street, Shoreditch, E.
Edwards, Robert W., Sutton, Surrey.
Farnan, Henry, 155, Amhurst-road, E.
Fowler, George Cupit, 18, Finsbury-street, E.C.

Gill, John Beadnell, M.D., Camden-lodge, Baldslow-road, Hastings.
Goldsmid, Major-General Sir Frederick John, C.B., K.C.S.I., 3, Observatory-avenue, Campden-hill, Kensington, W.
Greig, Andrew, C.E., Dundee.
Gwynne, Francis A., 15, Bury-street, St. James's, S.W.
Hassall, Harry Buckley, Currier Slack's, Ashton-under-Lyne.
Haviland, Alfred, M.R.C.S., Northampton.
Heldmann, Joseph, Brunswick-house, Shepherd's-bush, W.
Hellewell, Herbert, Bridge-street, Gainsborough.
Holmes, John, Laboratory, Somerset-house, W.C.
Howard, David, F.C.S., F.I.C., Rectory-manor, Walthamstow, E.
Hunt, John A, 2, Upper Chamberlayne-place, Southampton.
Huson, Thomas, 5, York-buildings, Dale-street, Liverpool.
Ibbotson, Alfred Buckingham, Villa Ibbotson, Fuori di Porta Romana, Florence.
Jones, J., 117, Newgate-street, E.C.
Jones, Robert Hesketh, J.P., The Briars, Crystal Palace-park, Sydenham, S.E.
King, William F., 9, Bessboro'-gardens, Pimlico, S.W.
Lock, Charles George Warnford, 88, Mostyn-road, Brixton, S.W.
Macan, Francis William, 79½, Gracechurch-street, E.C.
Maginnis, Rev. D., Old Parsonage, Stourbridge.
Massey, Henry, 41, Park-street, Grosvenor-square, W.
Milligan, Joseph, M.R.C.S.E., 6, Craven-street, Strand, W.C.
Mitchell, Rev. George S., Granby-row, Manchester.
Moffat, Robert John, F.R.G.S., F.S.S., The Chestnuts, Great Shelford, near Cambridge.
Muir, Hugh, 30, Lombard-street, E.C.
Nathan, Hon. Henry, 110, Portsdown-road, Maida-vale, W.
Nesbett, George, Bournemouth.
Ommanney, Captain Montague F., R.E., 1, Downing-street, S.W.
Orr, John B., Ellerslea, Eltham, Kent.
Parkin, William, 15, Westbourne-road, Sheffield.
Pascall, George William, High-street, Chelmsford, Essex.
Perrins, James Dyson, Davenham Bank, Great Malvern.
Perry, H. R., Vernon-house, Spring-grove, Isleworth.
Pfleiderer, Paul, 9, Mount-villas, Lower Norwood, S.E.
Phillips, Sydney Moreton, Newbridge, Mon.
Powell, John, 2, Huskisson-street, Liverpool.
Ramage, John, 34, Cranfield-road, Brockley, S.E.
Rensburg, Henry Edward, 37, Bentley-road, Prince's-park, Liverpool.
Robinson, Sir William Rose, K.C.S.I., Athenæum Club, Pall-mall, S.W.
Sanderson, T. H., 65, Wimpole-street, W.
Simpson, W. Speirs, 49, Battersea-park-road, S.W.
Tapling, Thomas, jun., 31, Gresham-street, E.C.
Thomas, William Henry, 97, Cheapside, E.C., and 5, Vulcan-road, New-cross, S.E.
Walrond, Theodore, C.B., Springfield, Taplow.
Watts, Edward, 57A, Hatton-garden, E.C.

The paper read was:—

APPRENTICESHIP: SCIENTIFIC AND UNSCIENTIFIC.

By Silvanus Phillips Thompson, D.Sc., B.A,
Professor of Experimental Physics in University College, Bristol.

Apprenticeship is the process by which a boy or an inexperienced man apprehends or learns to practice any craft, art, trade, or profession.

Inasmuch, also, as the process of thus acquiring a craft or art was in time past, and in some cases is still, made the subject of a legal contract whereby the master binds himself to instruct the apprentice, and the apprentice to serve his master faithfully, the term apprenticeship is sometimes applied to the legal contract entered into to insure the instruction of the apprentice. The term is also sometimes loosely applied to the period of time during which such process of learning is continued.

Since, then, apprenticeship is a process of learning something, it is clearly, like every other process of learning, subject to definite principles or general laws. Just as there is a right way and a wrong way of learning to read, or to cipher, or to write, so there is a right way and a wrong way of learning a trade or an art, a handicraft or a profession.

Unfortunately, although in each case this observation may at first sight appear to be a truism, it is strange how far the majority of mankind are from believing that there is a genuine science of education, the general principles of which are equally applicable not only to the processes of learning how to read, to cipher, and to write, but also to those of learning how to build houses, to print books, to construct machinery, to compound drugs, or to mould porcelain or glass.

A system of apprenticeship founded upon an intelligent apprehension of these general principles would clearly be defined as a scientific apprenticeship, whilst an apprenticeship in which all such rational general principles were ignored or violated must be as distinctly pronounced an unscientific apprenticeship.

In order that we may realise the vast difference which exists between a scientific and unscientific apprenticeship, let us take an example of a definite nature. I therefore select, from amongst the various trades, crafts, and professions, that one in which the idea of a scientific apprenticeship is, in my opinion, most nearly fulfilled, and which happens to be the profession of medicine and surgery.

Suppose we had the duty of training a youth for the medical profession, what kind of training should we give him to prepare him for his career? I presume we all know that no man can practice in this country as surgeon or physician without a diploma or license, and that such a diploma or license is only granted to those who have been for several years pursuing a course of studies in the theory and practice of their future profession, and have attained to a certain degree of proficiency, as attested by the certificates they produce from one or other of the various recognised medical schools.

Suppose, however, that leaving the accepted routine of lecture-going, reading, dissecting, and hospital practice, prescribed in the schools of medicine for our young aspirant, we were to adopt the following course:—Keep the youth for five years studying metaphysic and dialectic; then, at the end of this period, send him straight to work amputating and drugging, under the directions of an overlooker, whose best qualification was that he could drive the young student through the greatest amount of paying work in the shortest possible time. Suppose, moreover, all theoretical instruction, all access to books, to be carefully eliminated, and that meantime he should be taught to laugh

at and despise the notion that theoretical knowledge was of any service to him, even dissection, for the sake of adding to his knowledge and experience, being forbidden him as not being paying work. Suppose this to go on for seven long years, the only change in the routine being that towards the close of his time that he should no longer be required to perform such menial offices as washing floors or running errands. Suppose, I say, this course to be adopted and deliberately defended as a system of medical education, what would be thought of it?

Yet, strange as it may seem, the outrageous course which we have allowed ourselves to suppose is a faithful analogue of that which in thousands and hundreds of thousands of cases is going on to-day, not in the apprenticeship to the medical profession, but in the apprenticeship to the handicraft trades. For the five years of metaphysics, read five years of purely literary study in the elementary school; and for seven years of unintelligent and uninstructed work, read seven years of unintelligent and uninstructed drudgery in a workshop under an uneducated, unsystematic overlooker, selected for that post simply because he is a good slave-driver; and you have a not overdrawn picture of that which goes by the name of "apprenticeship" in too many of the handicrafts of England.

For, in brief, this is what we do when we have a boy whom we propose to bring up as a carpenter. Firstly, we keep him at the elementary school until he can pass the Fourth Standard, or until he is 13 or 14 years of age. All these years, from the age of eight onwards, he has done nothing but sit at a desk, pen in hand, so to speak, working at studies of an almost purely literary order, and which are only in the most remote manner adapted to the conditions of life he will be called to fulfil. We keep him at school so long that he has almost or altogether lost the taste for work, and would rather starve on a pittance as a clerk than don the workman's clothes to win a day's wage with an honest day's work. Of the uses of tools he knows nothing, possibly not even their names, and of the common things of nature he is profoundly ignorant.

The creature thus prepared in the Board school is, however, to be made a carpenter, and forthwith he is suddenly transferred to a big workshop, where he is greeted on all sides with sights and sounds wholly new and strange, where a language completely different from that of his school teachers is in vogue, where he begins at once to forget all that he had previously learned, and where he must abruptly conform to a new order of things. He is placed under a journeyman carpenter, who is supposed to look after him, but who, having his own work also, and not being paid to teach apprentices, nor, indeed, qualified so to do, loses no opportunity of neglecting him. The boy must do some work, so the first odd job that may be supposed easy enough is set before him, he has the very vaguest instructions given him, and nobody troubles to explain to him the difficulties he will encounter, or tell him how to overcome them. He spoils two or three pieces of wood before he has produced anything, and is simply sworn at or threatened with blows at each failure. Of instruction there is none, for the workman who ought to have instructed him could not do so if he would, having been reared under the same vicious system; and would not if he could, as he has no mind to be displaced by a clever young workman who could do his work for less wages. So the lad learns, with weary months of aimless and unsystematic labour, to ape the tricks of the elder workmen, falling irrevocably into their worst methods, and acquiring their slang talk. He is, of course, a perfect slave to the inaccurate "rules of thumb," handed down in the traditions of the shops. As to consulting a book about his work, the idea is too ridiculous to be named, and he learns to laugh in turn at the idea that he can be taught anything valuable in his craft except by "a practical man." At first, before his hands have acquired any rude kind of skill, he is the common drudge, must run for one man's coat, and for another's tobacco. From the moment when he has obtained some skill with his fingers he must be continually producing paying work, and so, without regard to that which would be best fitting him for doing further work, he must drudge on, planing mouldings or shaping legs of stools by the year together. He does not know how to describe his work, could not read his instructions aright if given him, as they ought to be, in the form of a working-drawing, much less could he himself set out a working-drawing for another to work by. So he grows up an uninstructed, uneducated, bad workman, and, having served his seven years' of apprenticeship duly, cannot well be forbidden entrance to that haven of bliss, the Union of his trade, where having entered he can claim to be paid, at least, as well as his fellow workmen. And this is apprenticeship.

Does the picture seem too grotesque or too strongly coloured to be true? I can assure you it is a photograph from real life, and not very remote from being typical of apprenticeship as it exists in many a workshop. What is the state of apprenticeship amongst the mechanical engineers? Let me give the opinion of Mr. James Hopps, as recorded in his report to this Society upon Mechanical Engineering at the Paris Exhibition.*

"In England, at the present time, as soon as a boy is sent to learn a trade all mental instruction is discontinued. He conceives that he has only to learn to work, and in this he is very much encouraged, both at home and in the factory; at home, by the indifference of his parents; in the factory, by the indifference of master and foreman. In fact, he is looked upon as a nuisance and in the way for the first year or two; he is set to do the most trifling jobs, and discipline is often so loose that he becomes a confirmed skulking sloven, his powers of mischief being the only faculties that evince development. The reason for work being done in a particular way is rarely put before him, and it is only when he is grown to man's estate that he begins to be regarded as of any value. The foreman, perhaps, notices what branch he shows most aptitude for, vice, bench, or lathe, and to this he is put and kept for the remaining term of his apprenticeship. By this means he becomes, perhaps, a fair turner or fitter, but rarely both. The neglect of mental training during his apprenticeship is so absolute that he is a worse scholar by far than when he left school. He lives and works—it may be steadily and soberly—but, at the best, like a mere machine. In many cases he does not know how to make the simplest calculation in relation to his work."

* "Artisan Reports on the Paris Universal Exhibition of 1878" (Published for the Society of Arts), p. 274.

It is not needful to multiply instances; every one who has thought over the subject at all must recognise the utter want of method and reason which pervades the training of apprentices in most of the handicraft trades, and must know how true is the oft-repeated complaint on every hand that good workmen are not to be had. In the old days, when the master was a craftsman first, and, perhaps, a capitalist in consequence, matters were very different, for the master charged himself with the education of his apprentice, taking a pride in instructing him in all he knew of his work, and treating him as one of the family—almost as his son; and you will doubtless remember that it was no uncommon thing, as with the industrious apprentice portrayed to us by Hogarth, for the apprentice to become his master's son-in-law. We have but to read the apprenticeship clauses of the time-honoured oaths administered on admission into the ancient guilds to recall the profound strength of this obligation of the master towards those who were to hand down to the future generations the secrets of the craft. But all this changed when changing social conditions replaced the master craftsman, worker in his craft, and paternal in his relations to his apprentices, by the capitalist, a non-worker, who could not instruct his apprentices, and could only set them to work through the agency of a middleman or overlooker. That which was logical, though perhaps unscientific, in the old apprenticeship of the pre-scientific middle ages, in this handing down of the craft from generation to generation of workers, became not only unscientific but illogical as the great, though almost imperceptibly slow, changes of the social fabric worked their inevitable course. So that what we to-day call apprenticeship is but the withered husk of the once living institution, lacking in all those essential elements which gave it vitality and coherence.

If, then, the present so-called apprenticeship, handed down to us as the descendant of the old paternal apprenticeship and inheritor of its name, and of its legal prestige, and of scarcely ought else beside, must be condemned as irrational, unscientific, and out of harmony with the social conditions of the age, what can be suggested as a logical and scientific substitute to take its place in social economy? What system is there, either actual or possible, that can do for our future craftsmen and tradesmen that which the old paternal apprenticeship endeavoured in old time to do? What are the principles that must underlie the attempt to reconstruct in a manner adequate to modern, social, and industrial conditions, the rational scientific apprenticeship of the future?

Those general principles may, I think, be laid down without much difficulty: what difficulty exists will be found rather in the application of those principles than in their abstract enunciation.

Firstly, in learning to perform any handicraft operation, or to use skilfully any tool or appliance, it is evident that the ability to do that one thing rapidly and well can only be acquired by practice; and that the beginner must learn by doing the thing many times over, slowly and carefully at first, rapidly and well afterwards.

Secondly, where, as in the case of most skilled (and in many so-called unskilled) industries, the craftsman must know how to do a great many things, or to use many different tools, it is evident that the process of acquiring the complete knowledge of the craft will be much facilitated if the learner be not kept doing over again that which he already knows how to do rapidly and well. Having gained skill in one operation by doing it often enough to acquire speed and precision, he ought at once to set about mastering the difficulties of some other operation. If he is kept for months or years doing over again and again that which he already knows how to do rapidly and well, employed as a cheap machine simply to put money into his master's pocket, he is losing just so much time of his apprenticeship.

Thirdly, all practical operations which have thus to be learned by repetition ought to be presented to the young apprentice in a graduated order best suited to his growing powers; the easy first, the harder as he gains power and knowledge. There is in every craft an order in which the round of skilled operations are best learned, an order not to be hastily settled, but known only to those who have themselves been trained and have had to train others, and is clearly an order in the course of which the learning to do one thing shall best prepare the way for the learning to do the next. The round of manual acquirements ought to be rationally and systematically arranged.

Fourthly, no apprentice should be allowed to do anything without being shown or told how to do it. It is a point of the utmost importance that the young workman should never be allowed to work unintelligently; the habit of unintelligent working once acquired is hardly ever thrown off. The prevailing idea in this country seems to be that a man ought to learn how to do a thing by simply doing it; whereas the *rational plan is to ascertain first how it should be done, and then to do it.* There is always a best way of doing a thing, known only to men of intelligent practical experience. No work should be attempted by a beginner until the method and *rationale* of it has been explained to him. He will thus be saved from trying bad and useless methods, and will be called upon to use his reasoning faculties. There can be no question that theoretical knowledge may thus be of great service in saving a workman's time. This constitutes, indeed, the main difference in many trades between the practical training of English and Continental workmen. One is supposed to learn simply by doing the thing over and over again, blindly and unintelligently; the other is supposed to learn by first learning how the thing ought to be done, and then doing it.

Fifthly, instruction in the general principles of science, which underlie almost all handicraft trades, ought to be taught systematically to the apprentice by teachers who understand what they are teaching, and who also are acquainted with the practical details of the applications of those principles to the particular trade followed by the apprentice, so that they may be able to point out continually the agreements and the apparent discrepancies between abstract theory and the actual methods of practice dictated by experience.

Sixthly, instruction in manual exercises ought to begin early. The dexterity of hand, the quick perception of the eye, are not to be attained after a certain age. In many skilled crafts this age is

indeed very early. Musicians know how early the child must begin to practice whose fingers are to acquire a perfect training, and there are many industries requiring a skill of hand little short of that which the violin player or pianist must possess.

Seventhly, throughout the period of apprenticeship, but particularly in its early stages, the manual exercises set to the apprentice should be chosen solely because they will improve his growing capacities; the idea of making him do paying work ought to be set aside. The thought should be, not what will pay now, but what will pay twenty years hence. Therefore, every other consideration should be subordinated to the desire to improve the skill of the apprentice.

Eighthly, to give breadth and generality to the practical knowledge of the apprentice, he should, in the early stages of his training, see something of various kinds of work; there being undoubted advantages in a carpenter, for example, and a smith knowing something of each other's work. Too early a specialisation cramps the powers alike of the hand and of the eye.

Having thus laid down the general principles of a rational apprenticeship, I think if we once more consider the method of training a lad which is in vogue in the generality of the British workshops, we shall see that it violates almost every one of these fundamental propositions. It is very seldom that the foreman or journeyman of the workshop can be found who will set systematic exercises to the young beginner, insisting that he shall learn to do one thing at once with precision and speed, and then proceed without delay to the next. Still less often will such a one instruct the beginner in the *rationale* of each operation, showing him how and why the thing can theoretically be best done, or instilling into him the general principles of science as applied to his trade. And when we ask where the workshop exists in which the work given to the young apprentice is chosen solely with the view of assisting him, and not because it is a paying job, we ask in vain. Our medical students must spend weeks and months in dissection and other exercises solely for their own good. Musicians must practice scales and exercises which bring no pay to the performer. Art students must draw, and model from the antique, studies on which they can never realise a penny; and pharmacists must go through a course of chemistry, and analyse very unprofitable decoctions, solely to gain skill. But neither the carpenter, the smith, the mechanician, the watchmaker, or the printer is put through a course of practical studies solely to promote his skill. To make bad worse, the time at which the training the hand and eye must be acquired is postponed often till too late by forcing the future craftsman to remain till he is thirteen or fourteen at a school in which the studies that would best help him on in the future find little place, and in which again he is being taught, not so much for his own improvement or advancement as for this, that his schoolmaster may gain a payment upon the brilliant feat of cramming him to pass a school examination.

Is there any place then, any workshop, factory, or institution where anything approaching a rational and scientific apprenticeship exists? Is there any trade, art, craft, or profession, the apprenticeship of which can be regarded in any sense as rational or adequate? Outside the limits of the so-called professions I know of none in England, unless we except the pharmacists. Thanks to the determination of the leading pharmacists of England, it is now almost impossible for a youth to obtain an employment as a dispenser of drugs without having spent some months in a pharmaceutical school or college, in addition to the years of practical experience which he must serve in the trade, the degree of his attainments being tested by sundry examinations, worked on an unusually judicious and satisfactory system. But in the handicrafts and mechanical trades there is nothing approaching even this imperfect step towards a technical training, and certainly nothing resembling the systematical industrial training of certain schools abroad.

This brings me to a point of some importance, namely, the line which is advantageously but arbitrarily drawn between technical education, strictly so-called, and industrial education. This distinction was laid down in 1868 by a committee of the Society of Arts, who, in their report, defined technical education to be "general instruction in those sciences, the principles of which are applicable to various employments in life," with the express limitation that "for the purposes of discussion, technical education should be deemed to exclude the manual instruction in arts and manufactures which is given in the workshop." No authoritative writer on the subject has since given any definition which differs very materially from the above, and, as the distinction thereby drawn is unquestionably useful, the definition must, I think, be accepted. Nevertheless, I am not quite sure of the wisdom of thus drawing an arbitrary distinction, since technical education is of little avail to any person who has not received an industrial training also; and no industrial training is worth the name unless it is also, to a large extent, technical, that is, unless the teaching of manual aptitudes be preceded, accompanied, and followed by theoretical instruction.

Having drawn attention to this point, I propose now to turn to some of those continental institutions in which it appears to me the principles laid down as those underlying a rational and scientific apprenticeship may be seen in operation.

We are probably all aware of the innumerable and splendid technical schools and colleges which exist in Germany, Switzerland, France, Austria, Belgium, and even in Russia. I will name as types of them the *Polytechnikums* of Dresden, Stutgardt, Berlin, and Zürich, the three *Ecoles des Arts et Métiers* of Aix, Angers, and Châlons, and *Ecole Centrale des Arts et Manufactures* of Paris. These institutions do not profess to teach any trade or industry, except engineering, which in some of them is a special feature; they are colleges for applied science to which educated persons may resort to add to their technical knowledge. Hence, while admirable for giving to foremen, masters, and the professed teachers of applied science, the higher technical training those persons need, they do nothing directly for apprenticeship. Indirectly, however, they do a great deal in their respective countries for apprenticeship in the mechanical trades, inasmuch as they provide what in England we have no recognised means of providing—trained

men as heads of workshops; men who are superior to rules of thumb, and who have some notion how to train the young beginners placed under their charge.

There are also in Germany, Switzerland, and France a number of other institutions, partly technical and partly industrial in character. Such are the technical high schools of Hanover and of Chemnitz, and many of the superior *Gewerbe-Schulen*, *Fortbildungs-Schulen*, and *Handels-Fortbildungs-Schulen* of Germany. Such are the weaving schools of Chemnitz and of Crefeld; not to speak of the schools of dyeing, carpentry, forestry, and building which are found in various parts of Germany and Switzerland. Many of these are industrial, in the sense that they teach thoroughly and systematically the manual processes required in various arts and trades; but they are all of them, also, technical, in that principles are always taught as the guide of practice. They are places where a learner must learn how to do a thing before he does it, and when he is set to do it in the best possible manner. Be it observed, however, that very few of these provide a training which is intended to obviate the necessity of going through a regular course of work in a workshop. They are rather supplementary to such work. In the case of German schools, it must be remembered that these technical institutions are working parts of a harmonious scheme of education, which, beginning in the elementary schools, parts off the pupils on the one hand into the literary courses of the *Gymnasien*, and thence to the University, or, on the other, into the more modern *Real-Schulen* and *Gewerbe-Schulen*, the best pupils passing thence to the *Polytechnikum* or Technical College, or else directly into trade and commerce.

In France, a somewhat similar arrangement drafts off the literary pupils to the *Lycées*, and provides for those who are going into commercial or industrial life, the great modern schools, such as the *Ecole Turgot* and the *College Chaptal*. There are, moreover, the two great military schools, *St. Cyr* and the *Ecole Polytechnique*, a special school of architecture, and the four great engineering schools already named.

But there are also in France a number of lesser institutions specially designed to aid in the education of the apprentice, and though they are mostly isolated, of comparatively recent growth, and very diverse in organisation, they are of such capital importance, in respect of our present subject, that I must beg to speak in some detail concerning them. They are either schools in which the experiment is being tried of giving a rational apprenticeship in workshops, apart from the necessities or caprices of a trading concern, or they are factories in which, under the direction of enlightened men of business, the experiment is being tried of giving to the apprentices of the firm a rational and systematic course of instruction. In a little pamphlet which I have recently published, upon "Apprenticeship Schools in France," I have given a full account of the nature, organisation, and cost of many of these schools; a little additional information has since been published in the pages of the "Artisan Reports on the Paris Exhibition," already referred to. We may classify the most important of the institutions under three heads.

1. Schools which profess to give a training sufficient to qualify the pupil to enter a factory forthwith as a skilled workman, or apprenticeship schools proper.

2. Schools which prepare pupils for subsequent apprenticeship by giving them some manual and technical instruction along with an ordinary schooling, or schools preparatory to apprenticeship.

3. Institutions for giving technical instruction to the apprentices of a regular factory or workshop, or to the apprentices of some particular industry.

I.—Apprenticeship Schools Proper.

Of the first category are the three *Ecoles d'Apprentis* of La Villette (Paris), Havre, and Douai, the *Ecole d'Horlogerie* of Besançon, and the unique industrial school kept by the Frères Chrétiennes, in the Rue Vaugirard (Paris), known as the *Institution de Saint Nicolas*.

The three *Ecoles d'Apprentis* of La Villette, Havre, and Douai, are meant to train boys to become good workmen in the handicrafts in wood and metals, *i.e.*, carpenters, wood turners, cabinet makers, pattern makers, smiths, fitters, metal turners, and locksmiths. The Douai school is the oldest of these, and the least active. The Havre school, which I visited early in the present year, is in healthy operation. Some information concerning it is given in my pamphlet, and more recently Mr. Hodgson Pratt has described in the *Daily News* of October 31, 1879, the nature of this school and the scope of its operations.

The *Ecole d'Apprentis* of Paris, situated in the Boulevard de la Villette, is a school of similar character, but surpasses the Havre school in size, in the extent of its appliances, and in the general superiority of its organisation. The results attained by this school are truly striking. No pupil is admitted before thirteen, nor without his certificate of elementary education. The course of instruction lasts three years, about half the day being given to schooling, and half to practical work in one or other of the workshops. The lads, who go out at sixteen or seventeen, are able at once to rank as skilled workmen, earning a wage usually only obtained by those who have served a much longer apprenticeship in the shops, and in some cases to earn higher wages than the average skilled workman who is of age. Happily, the promoters of this school have viewed the experiment in a truly scientific spirit, and the exact date which they have kept upon all statistical matters enable a precise estimate to be drawn of the signal success attained by the school. The school was founded in 1873. Of 74 apprentices who had gone out up to August, 1877, 69 remained faithful up to the present year in the industry taught them in the school; and their average rate of payment on leaving had been equivalent to 18s. a week, reckoning 56 hours to the week's work; their average age on leaving being seventeen years and a-half. Some of these, the young smiths and metal turners, earn more than this, and receive from twenty up to thirty, and even thirty-two shillings a week, as soon as they go out to work. Now, this school is one where there is a graded series of manual exercises, where those exercises are undertaken solely to develop the pupil's skill without reference to their

commercial profitablenesss, where no work may be attempted until the how and why have been explained, nor until the piece of work has been made the subject of a proper working drawing. It is a school where regular systematic, technical, and scientific principles are both instilled in class and insisted upon in the workshops. The instruction is not left to uninstructed workmen, but is in the hands of competent teachers, the head of the workshop staff, for example, being himself a former pupil of one of the *Ecoles des Arts et Métiers*, and thoroughly imbued with the scientific spirit, while the teacher of physics is an accomplished assistant in the Paris Observatory. The director, M. Müller, is himself animated with the spirit of the institution, and conducts excellent classes in descriptive geometry and other subjects. M. Bocquet, the superintendent of the workshops, gives a course of technological lessons, which, beginning with descriptions of tools and bits of machinery, bolts, nuts, keys, &c., leads up a complete knowledge of machinery and of machine tools. Drawing, applied physics, applied chemistry, algebra, arithmetic, geometry, and even industrial jurisprudence form parts of the curriculum of studies. To visit this school and its workshops—and I have visited it seven times, and spent many hours within its precincts—is sufficient to dispel the notion that the rational scientific apprenticeship advocated here, and in my pamphlet on "Apprenticeship Schools," is an impossible or Utopian idea, incapable of existing anywhere, except on paper. The problem is solved; and it is now simply a question of cost how far this solution can be applied. The small collection of studies executed by the pupils of this school, which I am able—thanks to the kind co-operation of Dr. Müller and of M. Bocquet—to exhibit to-night, will give but a faint idea of the works undertaken by the pupils. A further account of the school is given by Mr. Hopps on page 269 of the Artisan Reports.

Let me next refer to the *Horological School of Besançon*, which is an apprenticeship school in many respects similar to that just described, but differs from it in being devoted to the interests of but one industry. Of the nature of the practical and theoretical instruction given in this school, and of its growth, and of the important part which it has played in aiding the truly astounding development of the watchmaking industry in France, I cannot now say much. The report of Mr. Ganney upon watch and clockmaking at the Paris Exhibition adds a good deal of information to that which I have already collected, and it fully confirms the view that in an industry in which the principle of division of labour is so fully carried out, it is utterly impossible without some such institution for any skilled workman to obtain that general round of knowledge and of practice which the training in such a school affords. Mr. Ganney particularly mentions the work of the head pupil of the school, a lad 17 years of age, and who had not yet completed his third year of attendance at the school. He had carried the school prizes before him, and in addition to drawings and models innumerable, had constructed about 50 watch movements, including a fusee keyless pocket chronometer, finished and fully jewelled, and ready for hair-springing, and a keyless repeater lever of complicated pattern, having not only set the jewels, but even made his own jewel holes. Mr. Ganney remarks that the wonder was how so much skill could have been acquired in so short a time as about 34 months; that as many years might have been deemed a reasonable time to learn so much; and that he doubts if the English trade contains any workman taught in England who could undertake to produce such a variety of work of equal excellence, no maker of repeating movements having been known in England for 50 years. In the face of such an opinion, from one so well qualified by practical acquaintance with the subject, can it be doubted that the method of teaching an apprentice his trade systematically and scientifically by competent men chosen specially to teach, and with a single eye to that which will promote the pupil's skill, is at least in this important industry an advance of enormous importance upon the old apprenticeship of the shops?

The *Institution de Saint Nicolas*, which I have named as an industrial school of some note, teaches no fewer than 16 different trades to pupils who go there to become apprentices. There is, however, an almost complete absence of technical teaching; the two hours' schooling given each day to the apprentices has no relation whatever to their work; and, except in map-engraving on stone and wood-engraving, there appears to be no science or system in the trade teaching, which is done by ordinary workmen. In the two departments named some excellent work is, however, turned out, and in these departments exercises are set graded according to their difficulty, which the pupil must execute simply to gain skill.

II.—Schools Preparatory to Apprenticeship.

I turn now to the case of schools which prepare pupils for apprenticeship by giving them some manual and technical instruction along with their ordinary schooling.

One school, and one such only do I know, the manual school of the Rue Tournefort, in Paris, known as the *Ecole Communale*. This is an ordinary elementary school, having two workshops attached to it, in which the older scholars are taught systematic work for about three and a-half to four hours a day, in carpentry, forging, turning, modelling, and carving. Of the kind of work executed by pupils of this school I am able, thanks to the kind courtesy of its director, Dr. Laubier, to show you some examples. To my mind the great advantage of such schools is not in any actual skill they impart, for the hours are too limited and the pupils too young for this; but rather in that it carries on the training of hand and eye begun in the Kindergarten, the cradle of technical education, and prevents that which is, alas, too often the case with the literary schooling prescribed by the Elementary Code of our Education Department, the growth of a distaste for manual toil liable to overtake those who do not go to work before they are 13 or 14 years old. Slight as are the exercises executed in this school, the system is nevertheless well conceived, the exercises being systematically arranged and appropriately chosen. The cost of this addition to the usual schooling is very

moderate, and these manual exercises appear to bring no detriment to other school attainments.

III.—Institutions for giving Technical Instruction to the Apprentices of a regular Factory or Workshop, or to the Apprentices of some Particular Industry.

We come now to consider a very heterogenous group of institutions and systems whose aim is to impart technical instruction to the apprentices of a regular factory or workshop, or to the apprentices of some particular industry. In France these are very numerous, and the operation of the French Factory Act of 1874 has added to their number very considerably. The provisions of this Act forbid the employment of children under twelve unless actually in receipt of a minimum of two hours' schooling a day, nor may children over twelve and under fifteen be employed more than six hours a day unless their elementary education has been completed. Unlike our English Factory Act, which recognises no schooling except the stereotyped course prescribed for "Public Elementary Schools," the French Factory Law extends its recognition to evening and half-time schools in which technical instruction, scientific or artistic, forms the main feature of the curriculum. A very large number of the manufacturers of Paris are therefore able to comply with the law by having on their premises a school-room fitted with suitable appliances, in which every apprentice is systematically taught during the period of his apprenticeship. Be it remarked, however, that many such schools existed before 1874, and the oldest are some of the best. Many of the goldsmiths and jewellers of Paris have thus little schools of art for their apprentices. M. Lemaire, the famous maker of opera-glasses, has thus, for thirty years, instructed his young hands, and now two hundred of his two hundred and fifty hands are of his own training. The course here includes the study of elementary mechanics and elementary optics, along with ordinary school lessons. So again, MM. Chaix and Co., the well-known printers, have had, since 1862, a school of typography for their apprentices, in which the instruction is divided into three courses—elementary, technical, and supplementary. The technical course includes a course of lessons on typography and types, on the theoretical parts of printing, on reading and correcting proofs, and on engraving. The supplementary course deals with mechanics, physics, elementary notions of chemistry as applied to printing, the history of printing, and even a dose of industrial economics. The apprentice compositors work for seven or eight hours in a separate composing-room, under a *contre-maître*, whose sole business is to instruct them; and the practical exercises set them are "such as to introduce successively to their notice all the various difficulties which they must surmount, in order to understand their business and become first-rate workmen." Mr. William Bright mentions this school in his report on printing amongst the reports on the Paris Exhibition.

Nor are private firms alone in thus providing something towards remedying the evils of the decayed apprenticeship system. There is in Paris an excellent school of applied art, holding evening classes at 339, Rue St. Martin, established by the Syndical Chamber of Jewellers and Goldsmiths, for the apprentices of the different firms represented in the chamber. From the point of view of the application of art to the particular industries named, the success of this school is remarkable. Some of the designs for jewellery, executed by pupils of the school, are extremely elegant and artistic. I have been told by M. Gréard, the late Director of Primary Education for the Department of the Seine, and now Vice-Rector of the *Académie*, that, at first, the Trades' Unions of Paris looked askance on the establishment of such schools; but finding the real substantial benefit that accrued to the industry as time went by, they have come round to recognise their value, and that some of them have even started schools on their own account for the apprentices who are sons of members of the Union. The *Chambre Ouvrière des Bijoutiers*, for example, has set up an evening school for art-teaching in the Quartier du Temple.

In Germany and Switzerland there are also excellent trade schools and technical evening schools, approaching in character those with which we have just been dealing, though they are usually organised on a somewhat wider basis. Many of the *Fortbildungs-Schulen*, *Gewerbeliche Fortbildungs-Schulen*, and *Handels-Lehranstalten* are technical schools, of a lower grade than the *Polytechnikums*, established chiefly for the benefit of apprentice boys, and afford an excellent supplementary education. The vast array of *Gewerbe-Schulen*, or trade schools, to be found in every German town of importance, testify to the universal recognition in that country to the need of adapting the education given to the artisan lad to the special needs of his future career. In many of these schools no doubt the teaching is excellent; but I have seen enough of them to know that they are often inefficiently provided with teachers. Nevertheless, the amount of good effected on the whole by these schools must be enormously great. And when we contrast the abundance of technical instruction, higher and lower, thus provided in Switzerland, France, Austria, Belgium, and in every province of the German Empire, with the utter absence of it at home,* it is impossible to avoid endorsing the opinion of Professor Huxley, that "The condition of England in these matters is simply scandalous." Such schools are destined to play a very important part in the industrial competitions of the future; and they have begun to make their mark. Thus the Horological School of Besançon played a considerable part in the movement, which has, within the last fifteen years, wafted nearly half the watchmaking industry across the Juras from Switzerland into France. In ten years (from 1864 to 1874), the Swiss importations

* The only trade school of any mark in England is the excellent trade school of Bristol, founded by the late Canon Moseley. Our Schools of Art have done much, but might do much more. Our science schools and classes are, as I have pointed out elsewhere, lamentably deficient and cramped in usefulness by the arrangements of the Science and Art Department, and the teaching in them and the method of remunerating that teaching require radical re-organisation. There are a few other admirable institutions, such as the Artisan Institute, Castle-street, St. Martin's-lane, and the Birkbeck Institution. The Technological Examinations of the Society of Arts, and more recently of the City and Guilds Institute, have begun to do a good work. The classes of applied chemistry and applied physics recently organised by the Guilds' Institute, at the Cowper-street Schools, are another step in the right direction. But why do we not have scores of similar classes in every industrial centre?

into France fell in value from four millions of francs to one million and a-half, while the French importations into Switzerland—I am speaking of horological imports, of course—rose from less than four hundred thousand francs to over a million and a-half. The Swiss, seeing their trade forsaking them, immediately re-organised their three horological schools, and established three new ones; and I doubt not time will show the large wisdom of this step. The watchmaking industries of Clerkenwell and of Coventry are at a very low ebb, and a great deal of the best work purporting to be English is really imported from the Continent to be worked up here. Why cannot we, too, reorganise this ancient industry and regain our former prestige? Why do we not have a school of art metal-work in Soho or Clerkenwell, or a school of cutlery at Sheffield, to help us to fight the importation of tools, scissors, and other articles that America is sending into our markets? We have seen in Lambeth how a school of art may afford the most splendid aid to the revival of a lost art, or, rather, to what is almost the creation of a new one. Many a little local industry now dying of inanition, or confined within narrow limits, might thus assert a prosperous existence, or extend its operations far beyond their present range. Surely there is room for a school of jet-cutting at Whitby, and if the jet workers need an example to stimulate them there is one provided by the recent establishment of a school of coral-cutting at Torre del Græco, whose art products have, until quite lately, been as local as the art products of Whitby.

I have now reviewed, and that all too briefly, a few of the institutions in which an attempt is made to provide a rational and scientific apprenticeship in the handicraft trades, and there still remain several considerations, amongst which the foremost is how we are to obtain for English skilled artisans the benefits of the systematic training which so many of their foreign compeers enjoy, and which goes far towards making their apprenticeship a rational and scientific one.

Unfortunately, there are two difficulties ahead, which we cannot afford to blink. In the first place, we have no great technical schools or colleges such as France, Switzerland, and Germany possess for the higher technical training; hence we do not get scientifically trained men as employers, or as foremen and managers, or as teachers of technical classes and schools. Without these it is simply hopeless to begin with the apprentice. You cannot have the lower technical or industrial training without having the higher. And if you had the higher you would still want the lower. I am sometimes told in my advocacy of this scientific apprenticeship and of apprenticeship schools that the experience of France and Germany is against me, for there they educate, not the apprentice, but the master and the foreman. It is true that they do so, that the technical education they give is chiefly what I have termed the higher. France has had her great *Arts et Métiers* and her *Ecole Centrale* for nigh three-quarters of a century, and the magnificent institutions of Germany are, some of them, not much more recent. But France and Germany are alike finding out that they need the lower technical education also; and so we have on the one hand the *Ecoles d'Apprentis*, and on the other the *Fortbildungs-Schulen*. A single instance will illustrate this reaction. There is at Chemnitz, in Saxony, a "High Weaving School," one of the best of its kind, having fifty-four looms, twelve of them worked by steam power. This school was established in 1867. Since that date the manufacturers of chemistry have found it advisable to open an evening school of the type of a *Fortbildungs-Schulen* to instruct their apprentices in the theoretical parts of the weaving which they learn in the factories. I am confidently expecting to hear of a similar movement following the growth of weaving schools in Leeds, Huddersfield, Glasgow, and Bradford, for these weaving schools act the part of technical colleges for the particular industry, and do train the competent foremen and teachers, without whom the lower training of the apprentice cannot exist. I hold then that a necessary antecedent to the growth of a rational and scientific apprenticeship will be the establishment of technical high schools and colleges to train the men who will hereafter have the work of training the apprentices.

The other difficulty ahead is one which has greater elements of uncertainty in it—it is the divided attitude of the Trades' Union leaders towards technical education. While the best men amongst them recognise fully the value—the intrinsic value both to the industry at large and to the workers in particular—of thorough training, and are prepared to welcome cordially the technical education movement, and the elevation of labour by science, provided all reasonable securities be given that the just rights of those that represent labour be not trampled upon or impaired, there are others, unfortunately, who think otherwise, and who, seeing as it were, through but one pair of spectacles, cannot bring themselves to understand that a really skilled workman is much more likely to obtain constant employment and high remuneration, and to hold a more independent position towards the mere capitalist, than his unskilled and ignorant fellow-worker. It is too good to be true.

We may congratulate ourselves that there are men who, like Mr. Howell and Mr. Applegarth, know what technical training means, and who recognise its value. Let us hope that wise counsels will induce the thoughtful amongst the Trades' Union leaders in England to follow their brethren of France in helping forward all movements for the elevation of the skilled workman of the future. There is one other matter in connection with this that I must just advert to. If it were at all probable that many apprenticeship schools were to be suddenly instituted in all the skilled industries, so that in three years time the skilled industries would be flooded with an extraordinary proportion of apprentice labour, then I think the Trades' Unions would have some right to complain, and would be justified—from their point of view—in resisting such a result. But this is the last thing that is likely to occur. Apprenticeship schools cannot suddenly swamp the labour market, for the simple reason that we have not yet the higher technical training to provide teachers for such schools; and when we have these, it will take years to develop even a single school. The process of replacing workshop drudges by trained apprentices will be a very gradual one, and will be more likely indeed to make apprentice labour scarce than plentiful during the transition period.

There remain now only two practical points to which I must allude before drawing to a close. Careful observation convinces me that there are three essentials to the success of good apprenticeship teaching. Those essentials are good teachers, a sound system of instruction based in the handicraft trades upon drawing rather than upon written language or mathematics, and a real scientific training in the use of tools. Of the capital importance of drawing as a means of education, and of the prominence given to it in the most successful of all the apprenticeship schools, I have said so much elsewhere that I will not dwell upon the matter at greater length.

Of the value of a real scientific training in the use of tools, we can hardly make too high an estimate. In every trade tools are used, and the essential principles of the use of them are common to all, though the forms of the tools vary. Now, if there is one thing an apprenticeship school can do, it is to teach a boy the scientific way of making and using a tool. For example, in the La Villette school the boys make almost all their own tools, except files; on the one hand, they forge their own hammer heads, and on the other, construct machine tools, lathes, planing, slotting and shaping machines, and the like. But no boy must make a tool without knowing why it is to be made of the particular form chosen. He must sharpen his tools to particular angles, because particular angles are shown by scientific experiment to be best for certain work, giving the greatest effective result with least expenditure of labour. The course of technology in that school is a course almost entirely devoted to tools and machinery connected with tools. Amid the exigencies of trade in an ordinary workshop there is no time to study all this. Yet nothing can possibly be of greater importance to the workman. We see what attention is given to this matter in the United States, what striving there is to perfect tools and to invent new ones, and, depend upon it, all this is of vast significance for the future. Every advance in the use of tools means not merely an advance in producing power, but an advance in civilisation. You can read the history of the growth of human civilisation in the history of tools, from the flint implement down to the last new complicated labour-saving appliances. How comes it, then, that we have hitherto paid so little attention to this matter? Why have we not a science of tools—a science of organology (ἄργανον, a tool), if you will permit me to invent the term? Surely, in any future schemes for founding technical colleges, we shall find some place for this neglected branch of science. It is astonishing how little progress has been made in the forms of the commonest hand-tools for hundreds of years.* The hammers, the saws, the chisels have not changed since the days of William the Conqueror; yet there is room enough for improvement.

I have just now said that the essentials of success in the rational and scientific apprenticeship are good teachers and a good system of instruction, in which prominence is given to drawing and to the science of tools. These are the practical essentials; but there is one thing more essential still. We must first convince those most concerned that there is an absolute and imperative necessity for this entire reform.

There is no question whatever but that the persistent neglect of technical education in England will sooner or later ruin her in the markets of the world, which will be seized by less favoured but more highly trained nations. And the work of technical education is only half begun if it stops short of regenerating the education of the apprentice.

An organism which, having grown up under certain external conditions, finds the conditions which environ it changed, must adapt itself to those new conditions or perish in the struggle for existence. If it fail so to adapt itself, it is doomed. Human institutions differ from organisms, however, in so far as the powers of the human race transcend those of lower creatures. Man has not only the power of adapting himself to external circumstances, but, in some cases, of adapting the external circumstances to himself, by virtue of his intelligent command over the blind forces of nature. Hence, in the struggle for existence of human institutions, every change, every new development, is the result of a compromise, as it were, between those external forces which man can change and those which he cannot. The old apprenticeship was a system which grew up under certain external conditions, which the lapse of time and the growth of science have changed for ever. It is virtually defunct, and all our best efforts to revive it could but galvanise it into unhealthy and spasmodic activity for a few brief years. We can no more exchange the existing social order of things for that of six centuries back than we can roll back the Thames from London-bridge to Oxford. To that new order of things our commercial and industrial institutions must conform, or they will find themselves distanced irrevocably in the struggle. The skilled industries of Great Britain, with their irregular bands of workers, trained anyhow, nohow, armed with fantastic scraps of empirical knowledge, and swaddled up in rules of thumb, are doomed before the industries of nations who bring into the field ordered legions of trained workers equipped with intellectual weapons, and clothed with sound science. Against such adversaries all the stores of coal and iron in our hills and valleys will be of little avail. We have, however, one chance left; we must adapt our systems to the new social order, and organise and drill and train our workers in a systematic and scientific apprenticeship, in accordance with the dictates of right reason, and in harmony with the spirit of the age.

* We have heard lately of certain new American saws having alternately two long teeth between short ones, and denominated "Lightning Saws" from the speed with which they can be used for course work. But the "Lightning Saw" is at least three hundred years old. Had we had a science of tools every professor of that science would have had such in his knowledge, if not in his actual possession, at any rate as an historial curiosity, if as nothing more. During a recent visit to Germany, I had occasion to visit and examine a fine series of etchings by the great master, Albrecht Dürer. One of his most famous productions in that line of art is the picture known as the "Melancolia." It is dated 1514. It shows a melancholy woman resting from labour. On the floor beside her lie a plane, a hammer, and a saw of the type quoted.

DISCUSSION.

The Chairman, in inviting discussion, said that he had listened with the greatest gratification to Professor Thompson's paper, not merely on account of the obvious practical familiarity with the subject which it evinced,

and the valuable good sense it contained, but for a more selfish reason—because it entirely accorded with the views he had himself expressed, coming to the matter from a very different side. He had, unfortunately, no practical acquaintance with the kinds of work called handicrafts, but, oddly enough, he ventured some two years ago, in that room, to point his remarks with reference to technical education by analogy with the system of medical education, with which he happened to be acquainted, and to which reference had been made at the commencement of the paper. At that time he mentioned that there was a great stir going on, and that there was every hope of something real and practical soon being done, because the great City companies, who most assuredly possessed the means, were preparing to do something in the matter; in fact, the City Guilds had at that time done him the honour to consult him on the subject. Those who would refer to the advice he then gave, which he believed was printed, would find that it was in precise accordance with the principle which Professor Thompson had laid down. Whatever might be the merits or demerits of the old system, it was as thoroughly doomed in the different branches of ordinary handicraft as it had long been in physic. Circumstances had altogether changed, and it was quite impossible to think that by the old system of apprenticeship it was possible to obtain the results required for technical education. Under these circumstances, there appeared to him to be only two alternatives. We might bring within the reach of the young people employed in manufactures the means of carrying on their education beyond the time when the necessities of practical life obliged them to be at work. That was one suggestion, to establish in the neighbourhood of the great centres of industry schools whither those who were learning various trades could resort, and there receive that sort of education which would qualify them to work skilfully and intelligently at their trades. He then suggested another point of no less importance, which was, that the Guilds would do well to employ their large funds in the establishment of a central institution, which should do for the teaching power of the country that which such institutions as the Ecole des Arts et Métiers, or the Politechnikum of Zürich did for technical education in their respective countries, for, as had been remarked, at the present time it was not only the schools which were wanting, but the teachers also. He had now the great advantage of having the support of so practical an authority as Professor Thompson for thinking that these projects which had been proposed were of a sound and practical nature, and such as to advance, in the only way possible, the interests of technical education. He had, therefore, no criticism to offer on the paper with the exception of one remark, which he thought might probably be interpreted in a sense different from that intended by the author. He understood Professor Thompson to object to the existing elementary training in Board schools, on the ground of its theoretical nature, and of its occupying the minds of students entirely with books and book-work, and in teaching things which had no sort of bearing on the scholars' future life. No one wished more than he did, or, perhaps, worked more, when he was on the Board, to remedy the evil of exclusive book-work, and he had not the smallest doubt that the extension of the Kindergarten system, including the use of tools and the study of elementary machines, was a most important element in the instruction at Board schools; but he could not think that the evil of giving what he might call book-work instruction in the elementary schools was after all so very great. He did not think that up to the age of thirteen, when most children left the elementary schools, much was done to discourage boys from taking to this or that career, and he rather thought that the majority of boys would gladly go into the workshop, if only to escape the irksomeness of school. Therefore it would be well, if it could be done, to add instruction of some practical nature to the ordinary instruction in Board schools. Still, considering what the children were, the very short time during which the instruction lasted, and the further fact that, although it was important to make skilled workmen, it was even more so to make intelligent men, he did not think that four or five years spent in elementary schools were too much to give even exclusively to such matters as reading, writing, arithmetic, geography, the elements of history, and the rudiments of physical science. He did not think that any workmen would be a bit the worse, as a member of society, who gave these four or five years to such pursuits, if properly taught. The exceedingly interesting details which had been given with reference to Ecole d'Apprentis of Paris appeared to bear out this observation, because no one was admitted before thirteen, nor without a certificate of elementary education. It was a most remarkable fact, and very encouraging to those who wished to see technical schools established within the reach of the young working population, to see what good results could be obtained, and if the same thing could be carried out in England, the improvement to the British workman would be absolutely incalculable.

Mr. George Howell wished to correct a slight error in Prof. Thompson's remarks, with respect to the attitude of trades' unions. He had been acquainted with all the leading trade unionists during the last 20 or 22 years, and scarcely knew one who had taken any interest in public questions who could be alleged to be opposed to the views now put forward with respect to technical education. On the contrary, whatever little influence had been brought to bear in England, for the purpose of improving the present system of apprenticeship, had been done by trades' unionists —not always, perhaps, rightly—but they alone had endeavoured to oppose this downward tendency in our modern industrial system. Not only so, but so far as he had come into contact with them, they had also supported technical education. In fact, he was disposed to question whether they would have been in the position they now were had it not been for the attitude of these working-class leaders. What they felt was, that the old system of industrial apprenticeship was breaking down, and that nothing was being put in its place. They had been pitchforking a child into the workshop without any possibility of his learning his trade. In former days, the master knew his trade; or, at any rate, if the master did not the foreman did; and he had a certain amount of responsibility over the boy; but now it appeared that neither master nor overlooker knew anything of the trade, and the boy was put into the workshop, supposed to be taught by some one. The workmen had not only no interest in teaching him, but the whole of their interest went the other way. A man was paid nothing for teaching the boy, and yet was expected to train somebody else's child to supplant him and his children in the workshop. If it were not for the innate generosity of the workmen, the boy would go out as ignorant as he went in; but generally, if the boy showed attractive qualities, some one would take him by the hand, and show him how to do this and that, and at any rate he picked up something. They must look further than to the working man to find out the opposition to technical education. If those who took any interest in School Board work would refer to the discussions which had taken place over the recent elections, it would be seen that a great number of those who were opposed to what was termed the policy of the Board, demanded that children sent to these schools should be taught nothing but reading, writing, and arithmetic. Now, it seemed to him that an English mechanic should learn much more than that; no one could be a competent mechanic unless he knew geometry and drawing; at the same time he was not quite disposed to agree with all that had been said with reference to the

progress of technical education in some of these schools. On looking at some of the specimens of joinery, he must say they were not particularly creditable to the technical school which turned them out. There was not a scamping shop in London where they would permit sashes and doors to be made in the way these were. There was one thing that all must agree with, and that was that given an English mechanic, who had undergone some sound training, his work would bear comparison with that of any man in the world. Some of these specimens would show a great advance on the generality of work done in England, especially in turning wood and metal, but he saw from the diagram that the average outlay on a pupil was £35 18s. What would an English economist say if they atttempted to spend out of the national money £35 18s. a year in teaching one man Turning?

Professor Thompson said it was not per annum; it was the capital outlay.

Mr. Howell, continuing, said that in some particular branches there were no doubt some foreign workmen who altogether surpassed the English, but when at the Paris Exhibition he examined a great deal of metal and bronze-work, and found that the ordinary castings were absolutely inferior to those in English shops. When the casting went into the hands, however, of technically trained men to be finished, then the English workman was nowhere. He hoped that something would be done to stir up, not the working classes so much, because they did not require it, but the men of capital, to take an interest in this question. If they could not get the Government to do it on a liberal scale, they must try and induce the manufacturers and capitalists to invest their money, and there was no doubt it would come back to them 100 and 1,000-fold. He would wish to conclude by proposing a cordial vote of thanks to Professor Thompson for his very interesting paper.

Mr. Hodgson Pratt said there was another body of persons, besides capitalists and employers, who he hoped would learn a valuable lesson from this paper. He referred to the Science and Art Department and the Committee representing the Technical Educational movement in the City. So far as he could ascertain, the trustees of the Artisans' Institute, which he represented, had by no means been met in an encouraging manner by either of those bodies, when they attempted humbly to advocate the very principles now so eloquently laid down. He had seen a report very recently issued from the City, in which this very practical work, as completing theoretical instruction, was spoken of in this contemptuous way—"We are not going to teach boys to saw." The great principle which he hoped this paper would teach the authorities was that theoretical and practical instruction were husband and wife, and should not be separated. In a small way he had been trying for the last 10 or 11 years to promote technical instruction, and after the Paris Exhibition of 1867 he started a school for the purpose in Clerkenwell, but he fonnd that in consequence of the extremely imperfect primary education of the workmen they were not able to take full advantage of the classes started under the direction of the Science and Art Department. Words and phrases were used by the teachers every moment which they were nnable to follow, and diagrams on the black-board were quite insufficient to explain them. It was absolutely necessary, therefore, to illustrate theory by actual work done.

Dr. Gladstone, F.R.S., said he knew pretty well Professor Thompson's views on this subject, and had had the advantage in the summer of visiting some of these schools in Paris and Switzerland, when his attention had been very much directed, not so much to the apprenticeship system, as to the education which ought to take place in schools in order to fit the working classes for the work of life. He had marked for criticism the same paragraph which the Chairman had referred to, and which, he thought, went further than the facts would warrant as a rule. There were many elementary schools in which the education was purely literary, but in the best of them there was a good deal more taught than a reader of that paragraph would suppose. At the present moment there was a great talk about technical education, and many educationalists were desirous of introducing something of the kind into elementary schools. Hitherto it had been avoided, at any rate in boys' schools—he was not sure that it had, altogether, in girls'—but he thought there was a danger in some quarters of confusing somewhat the sphere of the elementary with that of the technical school. What they ought to teach in the elementary school, at the expense of the community, was that which would be useful to all the children in after life, not that which would be useful in the trade or business of this child or that. When they began to specialise instruction, it ought to be paid for by the parents, or by an endowment, or in some other way; it was not the part of the State to provide that kind of education. At the same time he thought the elementary teaching ought to lead up to the technical school; that the body and the various senses should be so educated that the child could turn easily to the use and comprehension of any kind of tools. The faculties should be so trained as to take up any kind of study which might be put before them. With that view they ought to go beyond what was indicated in the paper, and possibly beyond what the Chairman had indicated. They might start with the Kinder-garten, which was admirable for developing the powers of little children; then there ought to be object lessons, so arranged as to give the child some acquaintance with the various materials of which the world was composed, with which they would be occupied every day of their lives; and they should be made acquainted somewhat with the various forces of nature, which would become their masters if they did not make them their servants. In December last, he had spoken on this subject in that room, and gave information as to what was being done in the London Board schools; and since then, they had been developing the matter further, though even yet the system existed more on paper than in actual practice. Another thing they insisted on in all their schools was drawing, not because it was useful to a mechanic, or to a woman in cutting out garments, but because it educated the senses, and made the eye and fingers more exact. But while they did these things, they made a certain mistake with regard to special subjects. The Code allowed the teaching of certain science subjects to children in the three upper standards, four sciences being included, besides domestic economy, which ought also to be taught as a science; but ordinarily, the children had not been prepared for receiving instruction in these sciences, and hence he thought it would be better to devote some time to giving the children in the lower standards some rudimentary but correct knowledge of nature, rather than to keep them to book learning until they were ten, and then think they were prepared at once to enter on the study of physiology, mechanics, and other things. He should like to see every boy acquainted more or less with the fundamental principles of mechanics, but he believed that out of the 200 large schools only one took this up as a specific subject. It had been said that there was not time for teaching these things, and Mr. Howell had referred to the fight which took place with regard to the teaching of the three R's; but one very strong argument against this idea was that in order to give this mere literary instruction more thoroughly it was necessary to give the children an intellectual training, and that those schools which taught a great deal more taught the three R's best. In the London Board schools they taught drawing, object

lessons, and so on, but they also taught the three R's much better than any other large teaching body in the kingdom, no doubt because they endeavoured to educate the intelligence of the children and interest them in their lessons. He hoped they would be able so to mould the minds of the children as to fit them for whatever industrial or technical instruction they afterwards required. This subject was of the most enormous importance to the community, and he trusted it would be taken up by educationalists all over the country, and that a sound practical direction would be given to the movement.

Prof. Perry said:—Like every one else present, I am delighted that Professor Thompson should have made such a bold attack on the present system of English apprenticeship. He has marshalled the facts of our case in such a way that they must overwhelm anyone opposed to the idea that a change is necessary. It would have made his paper too long, perhaps, but I must confess that I expected something more from a gentleman who has so thoroughly studied the subject. We are all on his side. We all believe that our present system is bad. But we want to know how to proceed to remedy the defects of which we know so much. We know the methods adopted in France and Germany and America. But what is the peculiar method which has a chance of being successful in Conservative England. In other countries, trade-schools are often established for the sake of creating trades in districts where they barely existed before. This is not a need of England. In other countries the State has an unlimited right to interfere with trade by so-called protection; here, again, we have different conditions in England. It is only lately that attempts have been made in England to show that technical education is possible. Not to refer to the great college in Japan, with which I myself have been connected, we have shown in our engineering colleges, the School of Mines, &c., that such education is possible. But we need further experiments in this direction. All the objections to schemes of technical education which we hear of are based on the fact that apprentices who attend science classes do not find any great ease in learning their trade. This is quite true, but in it there is no evidence against technical education. If we consider how vaguely a pupil at ordinary science classes is acquainted with scientific principles; how far removed these principles are from being directly applicable in a man's trade; how well he knows that existing workmen get along without a knowledge of scientific principles, and the hundred other influences which cause him to doubt the usefulness of his scientific education, we shall discover the reason why attendance at science and art classes has hitherto seemed to be followed by no useful results. There is a very great difference in the position of an apprentice who has learnt a little theoretical mechanics and physics, and chemistry, and who has nobody to show him the application of his knowledge, and another apprentice who has been taught the application of scientific principles to his trade. I remember now, when I was a boy with a fair knowledge of mathematics, physics, and chemistry, I was miserable for a year after entering a workshop because I could not see any application of my knowledge to my trade. But my experience in Japan, and that of my colleagues, was that boys who had been carefully taught the application of their scientific principles to trades, picked up their trades, and very well too, from ordinary workmen in large workshops. Although, therefore, I think that it would be well if the condition of a trade, as to secrets, &c., enabled masters to employ an instructor to spend a quarter of an hour, say, per week, with each apprentice in the shop, I think that, on the whole, the present system will do very well if masters give all their apprentices opportunities of attending classes where instruction is given in the application of science to their particular trade. I say the present system, for I confess I think that the only proper way of learning that perfection of workmanship which is so characteristic of the English workmen, is for apprentices to work in a shop where there are more men than boys. In learning their trades boys must mix much with workmen, work near them, and on the same jobs, and lay themselves out to help and please the men whose manual dexterity they admire. Trade schools will not do for England, nor do I see how they can be established in numbers in any country which already possesses the trades there taught. To be efficient they must be expensive; the work turned out by them would be an unnecessary addition to the manufacture of the district. And I think that we have already in existence all that is necessary for the teaching of apprentices if it can be properly supplemented by technical education. The accounts given in the *Daily News* did not give me the idea of successful results at the School of Havre that Professor Thompson makes so much of. Mr. Howell has told us that the specimens of work shown on the table are bad in execution and principle. This is my own experience of such schools. We must clear from our mind the notion that trade schools can have much in common with the experiment at Havre, of which we have heard. Such workshops are the proper addition to any physical laboratory; they are excellent additions to the apparatus of a common school, as it is good for all boys to learn the use of simple tools, but a trade school, to be worth the name, must be a manufactory, competing successfully with the best manufactories of the district. Like many others, probably, near me, I have ideas as to how best to give technical education to English apprentices. Any scheme must recognise the fact that education in pure science is the care of the State, and that in a short time, what with the coming freedom from pecuniary difficulties of our primary education, what with the constantly improving action of the Science and Art Department, in a few years every boy and girl in England will have a fair knowledge of the elementary principles of physical science. Here end the functions of the State, and this is a good foundation to begin upon with our technical education. But I have already taken up too much of your time. I am glad to have had an opportunity of listening to a paper which points out so forcibly the necessity for immediate action being taken.

Professor Ayrton remarked:—I am sure we have all been extremely pleased with the admirable paper we have this evening heard. Ably has the speaker entered into what may be called the historical aspect of the question. At the commencement, reference was made to the education of a medical practitioner, and like a skilled surgeon has Dr. Thompson treated his subject. He has made a masterly diagnosis of his patient, and he has shown that the patient is dying of galloping consumption, but I venture to ask—has our lecturer not imitated the surgeon too closely? He has told us of countries where this disease does not exist; he has told us what a serious disease this consumption is, how desirable it would be for the patient to acquire a new pair of lungs, but how our English patient is to obtain this new pair of lungs our doctor does not tell us. "Technical education," the lecturer says, "was defined by the Committee of the Society of Arts to be 'general instruction in those sciences, the principles of which are applicable to various employments in life.'" If that is the definition they gave then, I venture humbly to suggest that I should think that they would now be very glad to use the light of further experience to modify it, for "the general instruction in those sciences, the principles of which are applicable to various employments in life," is a very good definition of the study of pure physics, but there is nothing technical about that definition. Technical education I take to be instruction in the appli-

tion itself of science to various employments in life. If the definition given by the Committee of the Society of Arts finds favour in Dr. Thompson's eyes, then one comprehends why he has given us instruction in those principles which may be applied to the education of our workmen, but he has not, I think, applied them as completely as his masterly treatment of the earlier part of his paper would have led us to hope for and expect. May it not be that the method of imparting technical instruction, like the method of doing anything else, must be learnt by practice, and that it is to those who have served an apprenticeship in imparting technical education that we must look for information regarding the best method to be adopted in introducing technical education into our own conntry? Pleased as one is to see these pretty specimens of the handiwork of French boys in trade schools, which our lecturer has brought with him and exhibited this evening, one must not forget that the comment already passed by Mr. Howell on the specimens of joinery before us, viz., that they are not only badly finished, but made on bad principles, is the opinion one hears from all English engineers who have had the opportunity of visiting and inspecting French workshops. The knowledge displayed by the French workmen in workshop economy is inferior to that possessed by our own men. One cannot, therefore, accept these inferior productions of French trade schools as any proof of the desirability of establishing in England "trade" schools. Mind, I am not speaking of "technical" schools, but only of "trade" schools. Again, even if the work turned out by the French trade schools were superior to that of an English workshop, one would have to be very careful not to be carried away with the notion that a system which suits a nation who tolerate the *gendarmerie*, who enter the theatres orderly like lambs, who will wait patiently an hour to take their turn for a seat in a tramcar, and who submit to be boxed up in the *salle d'attente* of a French railway station; it does not follow, I say, that a system which suits a nation governed so paternally, would necessarily suit our people so differently constituted, and with such different institutions from those prevailing in France. It will be, I fancy, a very long time before our masters of factories, with their English ideas of liberty and freedom, will admit into their workshops any form of instructors to come between them and their workmen, especially if we remember how carefully guarded at present are the secrets of any trade, and even were it not so, even were it possible to legally compel every master to have his men instructed in his own workshop in specially legalised methods of carrying out each trade, would it be good for the country? It was said the other day, by one of our most celebrated telegraph engineers, that it was worth noticing that the country (America) from which we were now obtaining almost all our inventions in telegraphy was the only one that had a telegraph administration totally unfettered by legislative direction. If, then, we cannot, so to say, put a "trade" school inside our manufactories shall we attach manufactories to our schools? Again I say no, emphatically no. To set up in connection with any educational institution a manufactory, where manufactories for turning out the same articles of commerce already exist, is an uneconomical superfluity, and has all the disadvantage attending the use of a machine for a purpose quite other than for which it was intended. Not to mention the enormous expenditure that would attend the establishment of manufactories in connection with schools, these manufactories, since they would be erected not to supply any existing demand for some article of commerce, but merely to furnish educational workshops, would not only be regarded with great jealousy by the masters and workmen of actories for producing the same article, but would probably quite fail to compete in the market with those already existing, and so would bring discredit on the whole system. A school or college is for training the mind and the body, not for the manufacture of saleable commodities. Leave the apprenticeship system, at any rate, for the present, as it is; leave the School Board to impart to our young the primary education, and the Science and Art Department the elements of pure science, there still remains a wide hiatus to be filled up. We have the lad who has left the primary school, and who is going to be apprenticed; we have the artisan, who is already following or learning his trade; we have the sons of rich manufacturers who are destined themselves, when they grow up, to become managers of works; and, lastly, we have, or rather we shall have to have, specialists to give all these three classes technical education. But as these specialists will, to a great extent, themselves have to be taught, there are really four large classes in this country requiring technical instruction. And it is to this large work that the City and Guilds of London Institute are turning their attention. From the notice that appeared this day week, the 26th of November, in the *City Press*, we may conclude that they quite realise the magnitude of their undertaking. To give technical education to boys during the day, and to artisans during the evening, they are starting in the City a technical school which must soon attain wide proportions from the number of trades in which technical education will have to be given. For the sons of manufacturers, and for the training of scientific instructors to be sent, after they have received their education, to teach "technics" in the various towns of England, the Guilds propose establishing a central college. This should be in the neighbourhood of museums, near the one that contains, for example, the remains of the "loan collection of scientific apparatus," that scientific text-book for reference of countless value. Small although this central college may be at first, it is hoped the Guilds will see the importance of securing, at the outset, sufficient land near the museums for the rapid extensions that must follow in the buildings, since no greater mistake could be made than to find that they had entered on one of the greatest educational movements of modern times on a piece of land only large enough for an ordinary school.

Mr. Watherston expressed his regret that time did not permit of continuing the interesting discussion, for he felt it difficult to over estimate the importance of the paper. All public questions had to pass through three stages, first, the pooh-pooh stage; secondly, the bow-bow stage; and thirdly, the "Didn't I always say so stage;" and, as one who had thought of this subject of technical education for years past, he must say he was deeply gratified to find that it was rapidly passing into the third stage. They all ought to learn something from the paper, and what he learned from it was that they wanted to re-arrange the Education Department, and the Science and Art Department, and more especially they needed a Minister of Education. When they had that, they would be nearer the time when they would have technical education laid on at the main. Another thing he had learned was that they should not be too impatient, but be contented with small beginnings. One of the schools referred to commenced with only 73 pupils and rapidly got to 221. He feared the City Guilds scheme was too ambitious with regard to the number of pupils, but not sufficiently ambitious with regard to the work to be done by combining theory with practice.

Professor Thompson, in reply, said it was quite true, as Professor Ayrton had said, that the French were inferior to the English in mechanical trades, and it was the consciousness of that inferiority which led them to found these schools. Complaints had been made that he had not given sufficient hints of a constructive character, but he had done so fully in his pamphlet,

which finished with ten concluding remarks, the third of which was a suggestion for re-organising the Education Department, and the last suggested the foundation of a central technical college in the metropolis; whilst the intermediate ones would be found to be of a more immediately practical character. Dr. Gladstone had called attention to the fact that those schools which taught more than the three R's, taught even those the best; that opinion he could quit endorse, and that was why he wished not to have a purely literary curriculum in primary schools. There were many other things which ought to be taught to children at school, but which were not, because such an extreme importance was attached to their being able to spell and write perfectly, and to do certain other things perfectly, which they did not require in after life. A spelling reform would cure one thing, and a reform in the table-book would cure another. He had the testimony of the best educationist in Paris to the fact that the three R's were well taught in the school which produced some of the specimens he had shown. Mr. Howell had taken exception to some of the specimens of joinery, but he could not bring good specimens, because they were mostly fixtures, bookcases and so on. What he had brought were simply specimens of what the youngest pupils made out of odd pieces of wood, showing the way in which they were taught.

Mr. Howell said that was what he objected to. No one who understood his business would allow things to be made in that way.

Professor Thompson said it was because it was recognised that French joinery was bad, that these schools were established. If the teachers were not sufficiently skilled, that was their misfortune, not their fault. With regard to metal castings, there was no technical school which taught that branch, but no doubt when they found out their deficiency they would improve. There was one place in France where technical education was thoroughly carried out, viz., Creuzot, and he did not suppose Mr. Howell would find fault with the splendid castings from that establishment.

Mr. Howell said it was precisely that group which he tested.

Professor Thompson said with regard to the cost, he had already explained that the sum mentioned was the capital, not the average expenditure; and the average amount was £10 4s. 6d. per pupil, which was less than the London School Board laid out for buildings alone; at the same time he thought it might be done more economically. With regard to the Chairman's remarks, he admitted he might have overstated the case with regard to the literary education given in elementary schools, but he knew there were schools where the education given did lead to a distaste for manual work. He heartily endorsed the opinion that it was better to make intelligent men than skilled workmen; but he advocated making intelligent men by making skilled workmen, not simply by setting them to work and expecting them to keep at it until they were skilled, but by teaching them to bring general principles to bear. Industrial training was not worthy the name unless technical training went with it. As to the other subjects taught in elementary schools besides the three R's, they were very limited in number, and, he believed, they would never have any scientific or manual training, or any knowledge of natural things worthy the name, until it was put on a level with regard to payment with other subjects; and until they had inspectors appointed, not from favouritism, or because they were graduates of some university, but because they were competent to examine in scientific subjects as well as in the three R's. Lastly, they required a Minister of Education.

The Chairman, in putting the resolution of thanks, wished to make an observation on something which fell from Mr. Hodgson Pratt. He knew nothing of the Science and Art Department beyond being connected with it as an examiner in certain subjects; but he entirely endorsed the substance, if not the form, of the remark which had been quoted. The Science and Art Schools were not meant to teach people to saw. The Department had its own special province, in which it had done great good, and would yet do much more, and that was the introduction of instruction in the elements of pure physical science. This was a large work, quite enough for the Department to undertake, and it ought not to interfere with other matters. Whose province it was was another question. A great deal had been said about a Minister of Education, and the State doing certain things, but he would say that, as far as London was concerned, he thought it would be an utter scandal and robbery if one shilling were asked for out of the general revenue to pay for technical education. There were in the City of London, at the present moment, the possessors of enormous wealth, who were the inheritors of the property and traditions of the old Guilds of London, which were meant for this very purpose, and if the people of this country did not insist on this wealth being applied to its proper purpose, they deserved to be taxed down to their shoes. Two years ago he was one of the instruments in indicating to a meeting in that room the good intentions of the Guilds and Companies of the City of London, and he confessed he thought it was time that those good intentions bore some practical fruit. It would be well if those who had charge of the matter would understand that they were morally bound, and that if they did not see that, they would some of these days be legally bound to do this work for the country.

The vote of thanks was carried unanimously, and the meeting separated.

CORRESPONDENCE.

SUGGESTIONS FOR DEALING WITH THE SEWAGE OF LONDON.

On reading the report of the discussion on my "Suggestions for Dealing with the Sewage of London," given in the *Journal of the Society of Arts* published yesterday, I was forcibly struck with the fact that a reader could scarcely understand what I wished to convey in my hasty reply to Dr. Frankland's observations upon my paper, and that Dr. Frankland and myself must have been unintentionally at "cross purposes" in reference to the amount of organic matter which one could reasonably expect to obtain in that portion of the sludge which I proposed to utilise as manure. As the probable success of my scheme greatly turns on this point, and as Dr. Frankland (even on the basis of his own estimate of what is practicable) thinks that the process I propose is "worthy of trial," whilst Dr. Voelcker considers that I had "avoided exaggeration in my estimates," and as, also, the importance of the whole question does not admit of exaggeration, I venture to repeat Dr. Frankland's remarks on this point in full, and to refer your readers interested in the subject to my paper. Dr. Frankland's remarks are as follows:—

"His experience was, that after the separation of the detritus from London sewage, the maximum percentage of organic matter was 63, whilst the minimum was 21, the average being 39½; and these high percentages were obtained under exceptionally favourable circumstances, because, in the collection of these samples of sewage, little or none of the so-called detritus was

mixed with it at all; it was to some extent a settled sewage, whilst the suspended matter was obtained by the most perfect process known to chemists, viz., by filtration through paper, by which almost every trace was retained. Under these circumstances, therefore, the mineral detritus was wanting, and there was a greater proportion of organic matter than could be obtained by the simple process of subsidence in tanks. He did not think, therefore, it would be safe to calculate on more than 33 per cent. of organic matter in the dried sludge, which would much reduce the value of the manure, for the value of a manure diminished in an accelerated rate as its strength was reduced."

I am not quite certain what Dr. Frankland intended to convey by the expression "after the separation of the detritus from the London sewage," but I presume that he refers to the sand, &c., dug out of the sewers and catch-pits, and, therefore, removed from the sewage before it reaches the outfalls. My argument, however, is based upon a comparison of the analysis of the sewage, as it issued from the outfall sewer, with its analysis as it issued into the Thames from the reservoir which receives it, and in which it is brought to sea. The first of these analyses, which are by Professor Williamson, F.R.S. (p. 22 *Journal of the Society of Arts*, November 28th), gives the ratio of the organic matter to the sand, and other mineral matters, as 1 : 1·9, and the second analysis, by the same chemist, gives the ratio as 2·25 : 1. It is manifest, therefore, that the sewage, as it issued from the outfall sewer, must be regarded, at any rate, as a very imperfectly "settled sewage," and that if such a liquid as that of the second analysis be allowed a period of quiescence, as I propose, the sludge, which would subside, would have a very different composition from that which would settle from the sewage issuing from the outfall before its flow had been checked.

That I did not intend to dispute the accuracy of Dr. Frankland's statement of the amount of detritus with normal London sewage, as I now read it, is evident from the fact that I have taken as my starting point a lower estimate of the amount of organic matter in normal London sludge than he does, for I take it to be 33 per cent. only, and he puts it at 39½ per cent. I regret that my misapprehension of his meaning induced me to reply to his observations in words which might lead others to the supposition that so accurate a man as Dr. Frankland could be mistaken concerning the results given in tables compiled from his own analyses, though I confess I supposed such must be the case, until I read the report of his speech which was generally so favourable to my scheme. I feared that it would be looked at through the medium of impressions derived from the analysis of comparatively valueless precipitated sludges, as was the case in the remarks of one at least of the speakers on my paper. Still, I venture to hold that I am not mistaken in saying that much of the detritus is still readily separable from the sewage as it reaches the outfall by simple subsidence only, and that it may be expected by this means to obtain a sludge degraded with no larger a proportion of detritus than that given by Dr. Frankland in his analysis of the sludges of small towns, quoted at page 29 in the first Report of the Rivers' Pollution Commissioners, or than I have ventured with this qualification, to assume. "The only point on which I myself see any grounds for doubt, is on the question of what proportion of the detritus it is practically possible to separate from the organic matter" (see *Journal*, p. 26). A very simple experiment would determine this.

Henry Y. D. Scott, Major-General.

Ealing, November 29th, 1879.

Having been unable to attend at the discussion of General Scott's paper, on the 26th ult., and having some experience in dealing with sewage sludge, I feel it incumbent upon me to offer the following short statement for publication in the next number of the Society's *Journal*.

About two years ago, General Scott offered me great facilities for using the patent which formed the subject of his communication to the Society, and he and I personally mixed a batch of sludge in one of my tanks in this fashion, first with milk of lime, and then with superphosphate mixed with dilute acid, exactly as described in his paper.

We tested a small quantity of the mixture for filtration through filter-paper against the sand sludge, and certainly found that the former parted with some of its liquid more readily than the latter, but I am inclined to think that General Scott exaggerates this advantage, as well as the difficulty of drying raw sludge. But my great objections to the proposal consist in the element of uncertainty which would be inseparably connected with its practical application, and in the loss of soluble and precipitate phosphate by drainage and drying, for one could not filter on a large scale through paper. I think that General Scott deserves great credit for not despairing of that intractable material, sewage sludge, but I regret that he should press for an experiment on such a large scale in face of difficulties, which my experience leads me to believe would prove fatal to this, as they have done to so many ground sewage schemes in the past.

General Scott is quite right in believing that the quality of the sludge can be raised by depositing the heavier detritus in a first tank, and the lighter part in a second one, a practice I have always followed; but I agree with Dr. Frankland that in practice he will not get his 3·50 of nitrogen and 6·07 tribasic phosphate of lime. Indeed, I am sure that it is a mistake to regard sludge as a valuable manure except as a make-bulk with which to dilute the most concentrated artificial manures, so as to bring them down to the standard at which they can be spread by the farmer. Of course, if a farmer has the command of some similar dry material at home, and is far removed from sewage works, he will do better to try his ammonia and phosphates, and make the mixture at his own farm; but in many cases it is otherwise, and I am convinced that sludge will gradually find its market in the way I have tried it for the last two years. This mode differs from that of General Scott in the following points, viz.:—

1st. By only using dried sludge I know what I am selling, whereas General Scott would have to make allowance for the variable moisture in his sludge, and such allowances are dangerous in practice.

2nd. Buying my fortifying agents only as they are wanted to make up orders, I have less locked-up capital.

General Scott can have no conception of the difficulty of placing 100,000 tons of manure in the market against the united opposition of the old established manure merchants and their ubiquitous agents; but if he will set up works on a small scale at a town in a good agricultural district, and keep on steadily offering a good article, in five or six years, I believe, he will establish a good business, and after a few such trials have won the farmers' confidence, the movement will spread so rapidly that something might be attempted for London. In the meantime he must, I think, fall back upon the scheme suggested by Mr. Cresswell in the discussion, for forming a vast alluvial deposit on the marshes at Maplin Sands. Alfred S. Jones, Lieut.-Col.

Hafod-y-wern Farm, Wrexham,
1st December, 1879.

Having had the privilege of receiving an invitation from the Council to hear the paper by General Scott, I was sorry to find that the discussion had to be concluded in the short space of one hour.

The first question which presented itself to my mind on reading the title of the paper was—What is London?

General Scott dealt only with metropolitan London, and in doing so accepted, I think wisely, the *status uqo* with regard to the existing metropolitan main drainage system, confining himself to showing simply how the present deposits of sewage at the outfall could be reduced. Dr. Frankland expressed a doubt whether the organic matter in suspension could, to any appreciable extent, be separated from the liquid by simple subsidence. I may say, in answer to this, that on a small scale, as engineer for the drainage works at Edmonton, I practically tested this for some months. The whole of the sewage was allowed time for subsidence in the underground storage reservoirs, and the quantity of deposit was such that I can confirm General Scott's estimates on this head, as within the mark. This was, of course, before I constructed works for the chemical treatment of the sewage, and making the requisite allowance for moisture and detritus.

If nothing more than the simple subsidence tanks proposed by General Scott are constructed, I think they will prove of great public benefit, and it seems to me to stand to reason that if the lighter matters will not deposit in the tanks when in a state of rest, assisted as they will be by every possible mechanical aid, those matters are not likely to be deposited in the river where, though there is an oscillating motion, there is always an absolute flow towards the sea. The sludge can be dug in as at Birmingham, and as we are doing on a smaller scale on the low lying land of the Board at Edmonton, and I think this will be found the only certain method of getting rid of it fast enough.

I do not think, especially from a ratepayer's point of view, that it would be wise to attempt to carry out at present the further extension of the existing outfall with the additional annual expense which it would involve. So much for London proper, with its 3,500,000 inhabitants.

It does, however, seem to me, that with respect to outer London, extending as it does now with its towns, hamlets, and villages, nearly 40 miles east and west, and nearly 25 miles north and south, and having something like a million of inhabitants, much more than the present haphazard system of treatment is necessary.

My own opinion is in favour of constructing a high level intercepting sewer, if not both on the north and south sides of the Thames, most certainly on the north side, with an outfall at Sea Reach. This sewer could be utilised also for intercepting some of the storm waters which at present cause so much inconvenience and partial flooding in the low lying lands, and the sewerage from the low lying districts could be pumped up into it.

There seems to me every probability that, by the time that metropolitan London has attained a population of 4,000,000 inhabitants, outer London will number at least half as many, and this must be my excuse for troubling you on the important though subsidiary question of dealing with the sewage of outer London.

G. Edes Eachus.

3, Great Queen-street, Westminster, S.W.,
November 28th, 1879.

OBITUARY.

Michel Chevalier.—In 1875, the Society of Arts awarded the Albert Medal to "Mons. Michel Chevalier, the distinguished French statesman, who by his writings and persistent exertions extending over many years, has rendered essential service in promoting Arts, Manfactures and Commerce;" and on Friday last (28th ult.), the long life of this consistent free trader closed at his country house, Montplaisir, near Lodeve. Michel Chevalier, the son of a small shopkeeper at Limoges, was born on January 13th, 1806. He commenced his career as a civil engineer in the department of the Nord, but having become a prominent member of the St. Simonian sect, then conducted by the Pere Enfantin, his prospects were shattered by a State prosecution. He was sentenced to one year's imprisonment, but at the end of six months was released by the Prime Minister Thiers. He publicly retracted all that he had written against the Christian religion, marriage, and social institutions generally, and was sent by Thiers on a special mission to the United States to study the system of railway and water communication in that country. His letters, containing an account of his journey, were published in 1836, and attracted much attention. He was then intrusted with a second mission to England at the time of the great commercial panic. In 1840 he was appointed Professor of Political Economy in the college of France, and he sat for a short time as a member of the Chamber of Deputies. He attempted, in 1847, with the assistance of Mons. Bastiat, to organise a league in France similar to the Anti-corn Law League, but without success. At the Revolution of 1848 he lost all his appointments; but after the *coup d'état* he was restored to his professorship and promoted to the rank of engineer-in-chief. In 1860 he negociated with Mr. Cobden the important commercial treaty between England and France; and in 1875 he was president of a society of capitalists, who signed, with the French Minister of Public Works, a convention for the construction of a submarine tunnel between France and England. Mons. Chevalier was elected a member of the French Institute in 1851, created a senator in 1860, and promoted grand officer of the Legion of Honour in 1861. After the fall of the empire he retired into private life, and only occasionally made his appearance at free-trade meetings at Montpellier.

GENERAL NOTES.

Sydney International Exhibition.—According to the official returns, the total admissions to the Exhibition on the first shilling-day (Saturday, October 4th) were 16,069.

Electricity applied to Bee-Rearing.—A correspondent of the *Deutsche Presse* describes a method, which he has adopted with success, of overcoming the obstacles frequently presented to the rearer of bees by the self-will of these insects, which consists in giving them an electric shock. Every one interested in bees knows the difficulties and dangers involved in hiving a swarm. One is often seen on a hot day in June in the top branches of a tree not to be climbed, and another in some inaccessible place seems to be preparing to set out on its wanderings. If the beemaster venture to approach, all his dexterity and experience will often not prevent him from being stung. There are, indeed, several cases on record of death following the stings inflicted on such occasions. Herr Freiwirth, the correspondent referred to, hit upon the idea of employing the electric force to stupefy the bees. Trials on large and small clusters, and even on single insects, answered perfectly: the bees coming in contact with the conducting wires fell stunned and motionless to the ground. They were then sorted and marked, according to the strength of the current applied. The time required for their recovery, varying from ten minutes to eight hours, was proportionate to the strength of the shock, but all came out of their trance safe and sound. Encouraged by the result of this experiment, Herr Freiwirth resolved to try it on a larger scale, namely, on bees in the hive. To this end, he introduced the ends of two conducting wires into a fully occupied honeycomb, and turned on the current for a moment; the bees soon lay on the ground, and it was half an hour before they resumed activity.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

DECEMBER 10.—"Art Vestiges in Afghanistan; the Result of Some Recent Explorations in the Jellalabad Valley." By WILLIAM SIMPSON. Sir T. DOUGLAS FORSYTH, K.C.S.I., C.B., will preside.

DECEMBER 17.—"The Panama Canal." By Captain BEDFORD PIM, R.N., M.P.

At the meetings after Christmas the following papers, amongst others, will be read:—

"Domestic Poisons." By HENRY CARR.

"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.

"The Utilisation of Slag." By CHARLES WOOD.

"Art in Japan." By C. PFOUNDES.

"The Trade and Commerce of the Yenisei." By HENRY SEEBOHM.

"Modern Autographic Printing Processes." By THOMAS BOLAS, F.C.S.

"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

"Art Ironwork." By J. W. SINGER.

"The History of Musical Pitch." By A. J. ELLIS, F.R.S.

"The Recent History of Explosive Agents." By Prof. F. A. ABEL, C.B., F.R.S.

"Iceland and its Resources." By C. G. W. LOCK.

"The Future of Epping Forest." By WILLIAM PAUL, F.L.S.

CANTOR LECTURES.

Monday evenings, at Eight o'clock.

The First Course, on "The Chemistry of Bread and Bread-making," five lectures, by Dr. CHARLES GRAHAM, F.C.S., F.I.C., Professor of Chemical Technology at University College, London.

LECTURE III.—DECEMBER 8.

Action of albuminoids. Rationale of kiln drying. Flour making. The dough. Action of moisture, heat, and albuminoids on starch.

LECTURE IV.—DECEMBER 15.

Fermentation. Leaven. Yeast. Ferments of disease. Changes produced. The use of the microscope in the examination of yeast.

LECTURE V.—DECEMBER 22.

Baking; changes produced by heat. Aërated breads; foreign breads; biscuits, &c. Digestion of bread a continuance of fermentation; conditions requisite. Conclusion.

The Second Course will be on the "Manufacture of India-rubber and Gutta-percha," by Mr. THOMAS BOLAS, F.C.S. It will consist of six lectures, to be given on the following dates:—Feb. 2, 9, 16, 23; March 1, 8.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 8TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Charles Graham, "The Chemistry of Bread and Bread-making." (Lecture III.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. P. Phipps, "The Working of the Education Acts in the Rural Districts."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Resumed discussion on Mr. Smalman Smith's paper, "The Law of Fixtures."
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Wilfrid Seawen Blunt, "A Visit to Nejd, Central Arabia."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Rev. H. R. Haweis, "The Origin and Influence of Music."
TUESDAY, Dec. 9...Farmers' Club, Inns of Court Hotel, Holborn W.C., 4 p.m. Annual General Meeting. 6 p.m. Annual Dinner.
Frübel Society (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Annual Meeting.
Folk Lore Society, 22, Albermarle-street, W., 8 p.m. Mr. Henry Charles Coote, "Catskin, the English and Irish Peau d' âne."
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion, "The Passenger Steamers of the Thames, the Mersey, and the Clyde."
Photographic, 5A, Pall-mall East, S.W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. "Communications on Australian Marriage Customs." From the Rev. L. Fison and Mr. J. Forrest, to Dr. Tylor. 2. Mr. J. A. Farrer, "Savage and Civilised Warfare." 3. Mr. Worthington G. Smith, "Exhibition of Sixty Specimens of Palæolithic Implements."
Metropolitan Scientific Association, 13, Blomfield-street, Finsbury-circus, 7 p.m. Mr. C. S. Bentley, "A New Theory of the Tides."
WEDNESDAY, DEC. 10TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. William Simpson, "Art Vestiges in Afghanistan; the Result of some Recent Explorations in the Jellalabad Valley."
Telegraph Engineers, 25, Great George-street, Westminster, S.W., 8 p.m., Annual General Meeting. The following Paper will be read:—Mr. E. March Webb, "The Operations connected with the Laying of the New Marseilles-Algiers Cable."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m.
Royal Literary Fund, 10, John-st., Adelphi, W.C., 3 p.m.
Society for the Development of the Science of Education, Memorial-hall, Farringdon-street, E.C., 7½ p.m. Mr. C. H. Lake, "Psychological Sequence."
Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 10½ a.m. Committee Meeting. 1 p.m. Annual General Meeting.
THURSDAY, DEC. 11TH...Royal, Burlington-house, W., 8½ p.m. 1. Dr. G. Gore, "Thermo-electric Behaviour of Aqueous Solutions with Mercurial Electrodes." 2. Messrs. J. Perry and W. E. Ayrton, "The Practical Solution of the most general Problems in Continuous Beams." 3. Prof. J. Dewar and Mr. A. Scott, "Further Experiments on the Vapour Densities of Potassium and Sodium." 4. Profs. Liveing and Dewar, "Quantitative Spectroscopic Experiments."
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. Walter Severn, "The Art of Sketching from Nature practically illustrated."
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
FRIDAY, DEC. 12TH...Astronomical, Burlington-house, W., 8 p.m.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, 8½ p.m.
New Shakespeare Society, University College, W.C., 8 p.m. 1. Mr. J. Mills, "On the Evidence that Shakespeare was, in 'Troilus and Cressida,' re-writing an old Play." 2. Mr. F. J. Furnivall, "Are the Philosophisings of *Achilles*, in 'Troilus and Cressida' (III. iii. 75—111), and of *Ayfidius*, in 'Coriolanus' (IV. vi. 37—55), mistakes in characterisation on Shakspere's part?"
SATURDAY, DEC. 13TH...Trade Guilds of Learning and Social Education League (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Free Lecture. Mr. Frank Storr, "The Merchant of Venice."
Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Mr. J. A. Fleming, "A New Form of Resistance Balance for Comparing Standard Coils." 2. Mr. J. H. Poynting, "The Graduation of Prof. Hughes' Sonometer." 3. Messrs. W. E. Ayrton and J. Perry, "A Dispersion Photometer." 3. W. E. Ayrton and J. Perry, "The Value of 'g-' at Tokio, Japan."
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, DECEMBER 12, 1879.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Tuesday, the 9th inst., at 4.15 p.m. Present:—Sir T. Douglas Forsyth, K.C.S.I., C.B., Vice-President of the Society (in the chair), Dr. Birdwood, C.S.I., Lord Alfred S. Churchill, Chairman of the Council, Major-Gen. Sir Frederick J. Goldsmid, K.C.S,I., C.B., Mr. W. A. Maitland, Mr. J. T. Wood, with Mr. H. Trueman Wood, Secretary, and Colonel Hardy, Secretary of the Section. The programme of papers to be read during the present Session was discussed and decided upon.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. W. H. PREECE, on "Recent Wonders of Sound" and "Recent Wonders of Light." The dates for the lectures will be Friday, the 2nd, and Friday, the 9th of January next. The lectures will commence at seven o'clock. As the number of seats is limited, admission will be by ticket only, and when sufficient tickets have been issued to fill the Room, the issue will be discontinued. The tickets will be supplied strictly in the order in which applications are received. Subject to these conditions, each member is entitled to a ticket admitting two children and one adult. The tickets are now being issued, and only a limited number remain for distribution. Members requiring them are requested to make application to the Secretary at once.

SOCIETY OF SCIENCE, LETTERS, AND ART.

It having come to the knowledge of the Secretary that circulars, purporting to be issued by "The Society of Science, Letters, and Art, of London," and dated from "42 and 44, Ennis-road, Stroud-green-road, near Finsbury-park Station, London, N.," have been sent to certain of the newly-proposed members of the Society of Arts inviting them to subscribe to the "Society of Science, Letters, and Art," he is desired to give notice to the readers of the *Journal* that nothing whatever is known of such a society at this office, and that it is not associated in any way with the Society of Arts.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 0th, 1879; Sir T. DOUGLAS FORSYTH, K.C.S.I., C.B., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bayley-Worthington, Gibbon, 2, Porchester-gate, Hyde-park, W.
Couchman, Colonel, 40, Pembridge-villas, W.
Garston, W. E., Blenheim-house, Marlborough-road, N.W.
Hall, John Parkinson, Crane-house, Great Yarmouth.
Peake, W. H., 29, Gerrard-street, Soho, W., and Balham.

The following candidates were balloted for and duly elected members of the Society:—

Brooker, Edward, 2, Rood-lane, E.C.
Colfox, Thomas Alfred, 9, Kensington-park-road, W., and Westmead, Bridport.
Fox, Samson, Castleton-lodge, Leeds.
Guthrie, Charles, 88, Cannon-street, E.C.
Holme, Charles, F.L.S., 4, Ornan-road, Haverstock-hill, N.W.
Mathers, Alderman John Shackleton, F.S.S., Hanover-house, Leeds.
Mitchell, Henry, 39, Mecklenburgh-square, W.C.
Perceval, Charles John, 8, Thurloe-place, South Kensington, S.W.
Roberts, Thomas David, The Grove, Malpas, near Newport, Monmouthshire.
Simpson, Thomas, Audrey-lodge, Ealing, W.
Smeaton, John, 24, Moorgate-street, E.C.
Vernon, Arthur, High Wycombe.
Yerburg, Armstrong, 5, Queen-street, Mayfair, W.

And as Honorary Corresponding Member:—

Jäger, Dr. J. G., Rokén 87, Amsterdam.

The paper read was:—

ART VESTIGES IN AFGHANISTAN, THE RESULT OF SOME RECENT EXPLORATIONS IN THE JELLALABAD VALLEY.

By William Simpson.

Having been quartered for some months last winter in the Jellalabad Valley, with the force under General Sir Samuel Browne, I was able to visit most of the remains in that region, and make sketches of them. In addition to this, I made a number of excavations, under the auspices of the late Sir Louis Cavagnari, and I propose to-night to lay before you some of the results.

From the date of the first Afghan war, now about 40 years ago, we have been aware of the

existence of Buddhist remains in the Jellalabad Valley. Owing to the exciting events of that period little or no attention was directed to their investigation. Our knowledge of Indian architecture was scarcely commenced at that time, and the importance of these old fragments of the past had not then begun to be felt. During the last 30 or 40 years much has been accomplished in this direction, and we have now collected a vast mass of knowledge, which, under able hands, is assuming something like a classified form. Not only are the numerous styles of architecture found in India being separated from each other, but many of the details are being wrought out and traced back to their origin. That of the Buddhists has not only a profound interest from its antiquity, and its connection with the worship founded by Sakya Muni, but its study brings us back to the earliest forms of temples, and to the most primitive modes of structure which existed in Hindostan. Lately, we have had large contributions to our knowledge in this direction, such as Mr. Fergusson's "Tree and Serpent Worship"—it is what might be called an exhaustive work, so far as details go, of two of the most important Buddhist monuments of India. Last year appeared Rajendralala Mitra's work on Buddha Gaya, and following fast on this we have Major-General Cunningham's "Stupa of Bharhut," both of them highly illustrated books, in which the Buddhist architecture can be studied as far back as the time of Asoka, or, 250 B.C. During the last ten years explorations have been carried on in the Yuzufzai country, the sculptures resulting from which are now in the Lahore Museum, and form another large addition to our knowledge. Being aware that we had no materials connected with this subject beyond the Khyber, the hope that I might be able to add something, however little, to our stock in this direction, gave an extra interest to the campaign when I crossed the frontier a twelvemonth ago with the Peshawer field force. I can now say thatI have brought home materials on which may be founded a knowledge of the Buddhist architecture as far as the Jellalabad valley.

The Buddhist remains of the Jellalabad Valley are little more than mounds. Here and there the crumbling remains of a stupa may be seen, and fragments of walls can be traced in the heaps. The immense quantity of these mounds astonished me; as we know that these Buddhist establishments were monasteries, the extent of the remains seem to me to indicate in the past a population of ascetics alone far greater than the whole population of the present day. This points to another fact of importance—there must have been more cultivation of the land in the Buddhist period than now. We found large plains of stones and dust which were in all probability bearing crops in former times. At the present there is no art or architecture. The houses are built of mud; the walls of Jellalabad are formed of this material only, and the gates are wooden structures of the rudest kind. In the Buddhist period, on the contrary, the country must have been under a high state of civilisation, where considerable wealth abounded, and art was cultivated. The vestiges of this art still remaining, show that the religious structures of the time were large and important. A style of architecture was followed, in which sculpture was largely practised, and in which the effect was heightened by the use of colour and gold. The two Chinese pilgrims, Fah-Hian and Hiouen-Thsang, visited the Jellalabad Valley, the first in the year 400 A.D., and the other in 630 A.D. They describe the stupas and monasteries which they saw, and speak in glowing language of their appearance. These travellers mention "veined stones," as having been used; "pierres précieuses" are common words, as were the seven precious substances; these last were gold, silver, lapis-lazuli, crystal, cornelian, coral, and ruby; most of the topes are referred to as having their decorations of these materials. Fah-Hian mentions a monastery at Hada, about five miles from the present Jellalabad, which was "entirely covered with plates of gold." These few statements tell something of the former material condition of the country, as well as of its art and architecture.

The structures connected with the practice of the Buddhist faith were viharas, or monasteries, places in which each monk had his cell, and with buildings for worship. One prominent form of the ritual was connected with structures, which are now known as "topes," or stupas. Tope is the term applied to these monuments in Afghanistan, and is now the word most frequently employed by archæologists, but "dagoba" and "chaitya" are also terms used to designate the same kind of structure.

The origin of these monuments can be so far explained, and the following, which contains nothing more than headings of the subject, extends over a considerable space of time, commencing at a remote prehistorical date. At an early period the simple grave heap was, in cases of important persons, increased into a large mound or barrow. Following this, stones were added, and the heap became a cairn. Later still the cairn took a structural form. In India, under Buddhism, this development assumed the form of the tope. It will thus be seen that the tope is essentially a tomb. That the Seven-Terraced Tower of the Euphrates Valley and the Pyramid of the Nile are only varieties of the same growth is highly probable, but the connecting links of evidence on the subject are as yet sadly deficient.

We are equally destitute of the connecting links between the Buddhist tope and the cairn. If any vestiges could be found in India to tell us what form the heap of stones had assumed towards the Buddhist period, it would be a discovery of some importance. There is represented among the sculptures on the gate of the Sanchi tope, a curious beehive form, with what seems like a couple of eyes upon it; also on the Amaravati tope a very similar structure may be seen. This may be an elementary form of the tope, it may even be the pre-existing type out of which the Buddhist tope was developed; still regarding it in our present state of knowledge, we can only speculate, nothing can be affirmed. The kings among whom the ashes of Buddha were divided, are said to have built topes over each portion which they received; if we were sure that this is reliable history, and not a legend of later date, it would be conclusive as showing that the construction of stupas did not begin with Buddhism. Other references from Buddhist authorities could be given as evidences in this direction, but it will

show their want of value to give one pointing the other way. Fiah-Hian relates, that at Nagarahara, the ancient Jellalabad, there was a stupa 70 or 80 feet high, which Buddha, assisted by his disciples, had erected "as a model for all future buildings of the sort."* The holy land of Buddhism is in the region round Benares, beyond which Buddha never passed, yet his followers in the Jellalabad Valley had shrines which owed their celebrity to the supposition that Buddha had performed some act on the spot. The legend connected with the construction of this model stupa just mentioned is an illustration of their unreliability. It will be seen from this, that these Buddhist traditions cannot help us much in the inquiry, and that we shall have to trust to the explorers among ancient remains for information on this head. At the present moment, our knowledge from this source does not reach beyond the times of Asoka, about 250 B.C. At that date, judging from the remains found at Bharhut by General Cunningham, the tope had become a fully developed monument. If the links between the tope and the heap, or cairn, could be found, and if the Vimana of the Hindu temple could be clearly traced again, as growing out of the tope, which seems to be a very probable theory, as far as we know at present, then we should have a long and most important line of architectural development reduced to a historical basis.

The topes of Sanchi, Bharhut, and Amaravati, were circular at the base. This form seems to have extended as far as the Indus, for the Manikyala tope, north of the Jheelum, the ancient Hydaspes, has this feature. On crossing the Indus a change begins. At Jamal Ghari there is one with a circular base, but close to that, at Takht-i-Bahi, there is another in which a square base is found. It may be worth noting here, that the chortens, the Tibetan name given to the topes which the Lamas, or Buddhist monks of the present day erect in the Trans-Himalayan region, have all of them square bases. This may be important as showing the probability of the Lamas deriving their particular form for their monuments from the right bank of the Indus, and not from the left; and this may prove important, as tending to the conclusion that the Buddhist propaganda had first crossed into the present Afghanistan before it penetrated into Tibet. After entering the Khyber Pass all traces of the round base cease. In every case it is square, and this form assumes the importance of being, not only a marked, but at the same time a distinctive feature of the Afghanistan topes. It is ornamented with a cornice and pilaster, large and imposing stairs were made to ascend to the platform formed by it above, on which the circular part of the tope stood. These stairs, implying the going up and down of the worshippers, would seem to indicate that some important part of the ceremonies was performed on the floor of this square base. The Sanchi topes have all a circular ledge near their base, also with stairs, but this is not such a noticeable feature in them as it is in the Afghanistan topes. Still we need scarcely doubt that, whatever purpose was served in the one case, a similar purpose was served in the other.

The Sanchi tope was a hemispherical mound of stone. The remains of the Bharhut tope are not sufficient to tell us what its shape was, but we may safely enough assume that the simple half round dome was the early form of the tope in India. The Sarnath tope at Benares is supposed to have been a later erection than those just mentioned, and it is elongated till it presents a shape approximating to the shikur or spire of the Hindu temple. The Jellalabad topes, from their height, might be described as circular towers surmounted by domes. They are now in such a ruinous condition that none of the domes are left. In one or two instances only, the outer masonry exists as high as the beginning of the dome. In those cases, by which a judgment can be so far formed of the height of these structures, a date, I think, must be given to them long after that of the Bharhut or Sanchi examples. Hence, it is quite possible that an elongating process may have been going on in Afghanistan similar to what took place in the more central region of India. I did discover the remains of an old tope, which had been built over by a larger one—a common practice with the Buddhists of Ceylon; in this case I only found what I might call the matrix—the form left by the original small tope, when it had been excavated at some previous time—and so far as one might judge from this, it indicated a shape much lower in proportion to its height than those which I presume to have belonged to a later date. I mention this as only probable, feeling how rash it would be to jump to a conclusion on so slight an evidence. Here, as in so many other lines of inquiry, we have to venture on the unknown and the probable, in order, ultimately, to discover the exact and the reliable.

I confess to the interest which investigations of this kind give to the mind. Old stones, or fragments of marble, unless they have good art on them, are not very attractive in themselves; but when a human motive becomes evident, or a development of ideas can be traced on ancient remains, a legitimate curiosity is awakened, and we are attracted, in hopes of learning wha twe can out of them. In the case of the art vestiges under consideration, we have the interest belonging to them which the study of the Buddhist religion has lately awakened. That remarkable system presents us with a number of very complicated questions, and the architectural remains of India, as well as of Afghanistan—if I ought to mark the separation of the regions—are associated with these questions in many ways. The points I am now about to deal with involve some considerations of another character, and these are connected with ancient conquests of India, and the art influences which resulted.

In the Buddhist architecture of India, we find a capital like an inverted bell. The Buddhist lats may be said to have nearly all had this capital. The old iron lat at the Kuttub, near Delhi, is a marked example. This capital is found as far south as the Karli Cave, near Bombay; and it is evident in the gateway, as well as in the sculptures at Bharhut; it is also represented in the sculptures at Buddha Gaya. From these instances it will be seen that this particular feature of a style had been widely spread over India. The resemblance of this capital to those of the Euphrates Valley had often been remarked, but the theory of a style of art

* Beale's Translation, p. 47.

crossing the Indus and penetrating as far as the places just mentioned, implied a process it was difficult to be quite certain about. Now, with the evidence before us, the matter seems tolerably clear. I have already alluded to the museum at Lahore. In it has been deposited the remains found in the Yuzufzai country. This is a district on the right bank of the Indus, and at a number of places, the principal of them being Jamal Garhi and Takht-i-Bahi, about thirty or forty miles north-east of Peshawer, excavations were made about eight or nine years ago. The existence of these places were first made known by Lieutenants Lumsden and Stokes, and the excavations were begun by Dr. Leitner, and afterwards carried on by the Archæological Survey Department of India under General Cunningham. Among the sculptures found, this inverted bell-shaped capital appears prominently. In those previously known in India, such as the iron lat at Delhi, we had little more than the capital as an identity on which to have based analogy with those of the Euphrates Valley. Having crossed the Indus in our investigation, we find further identity. The Persepolitan capitals had in some of them an upper member on which a couple of horses were sculptured. In the Yuzufzai sculptures we find this same member, but a change has come over it—instead of horses we have Brahmanic bulls represented, in many cases the work is rude, but the hump on the back is unmistakable—telling us that the style had undergone a change by coming to a land at a period when the cow was a sacred symbol. This Persian style I have traced as far as the Jellalabad Valley. In the examples found there this upper member existed, but plain—no animals were, as far as my experience went, represented upon it. At Ali Musjid some Buddhist remains were explored by Mr. Beglar, of the Archæological Survey Department, and the bulls were found on them.

The existence of a few capitals in the central parts of India were not exactly sufficient evidence on which to base the theory that the art they belonged to had come from the region of the Euphrates. These capitals were enough to justify speculations, but we were not quite so sure of the sources of Indian architecture, as to accept an idea that a style, or rather it might be called only the vestiges of a style, had made such a wide geographical leap. Now that these identities are found, and in ampler form too, across the Indus, and as far as Jellalabad, the difficulty of distance disappears. The evidence I have placed before you, has this value, it not only points to where the style came from, but also the route by which it travelled; and we may say, that what was before merely speculative, is now clearly established. Before dealing with the question of date, I may premise that the examples of this Persian style at present found in India and Afghanistan do not date from the time when the style first reached these regions. At Bharhut we have the bell-shaped capital on the gateway; in the sculptures at the same place there are representations of the buildings of the period, and this capital appears prominently as a well established feature of the architecture. It was in the middle of the third century B.C., that this condition existed, and it implies that the influence had arrived some considerable time previously.

The date at which Darius extended his rule to the Indus, is given as about 516 B.C., and this might give a period sufficient to account for the extension of the Persian style, as we find it at the time of Asoka.

We have a still older date which might be drawn upon to account for the introduction of this style. From inscriptions it is now known that Tiglath Pilezer had penetrated as far as Afghanistan, and according to Assyriologists, he drew tribute from at least one district of it, from Arachosia; this would be about two centuries earlier than Darius. If we assume that Assyrian art had features in common with the Persian, the influence may have received its first impetus at that more distant date. As Darius was able to have explorations made on the Indus by Scylax, we may suppose that his occupation had been more extended and well established, and his era is, therefore, the most probable time when the Persian style may be considered to have began its influence on Indian architecture.

This explanation of these vestiges of art in Afghanistan, as well as in India, receives very strong confirmation from the existence of another style in the same region, which was also brought by means of invasion. This was an influence by the Greeks after the conquest of Alexander. I will not say this influence did not spread beyond the Punjab, in fact, I am inclined to think it did, but as yet the inquiry on this head is speculative. Its existence in the country of the Five Waters, and in Cashmere, is no longer doubtful. As early as 1860 I made sketches in these localities, which brought conviction to my own mind. The explorations in the Yuzufzai district have added much to reduce the matter to a certainty. If this style was limited in its extention in comparison to that of the Persian, the influence itself seems to have been much greater. We have not only Corinthian and Ionic capitals, and something approaching very much to the Doric, but we have friezes, cornices, pilasters, and mouldings, all evidently derived from Greek sources. In addition to this we find that the sculpture in that region is impregnated with an influence from the same direction. Instead of the rigid manner of the more purely Indian style of sculpture, we find the drapery, the hair, the faces, and other details, treated with a freedom in which a Greek teaching is manifest. I must caution you against supposing that Greek buildings exist. In Cashmere, we have Hindu temples in which some of the features I have just named may be found. In the Manikyala tope, a purely Buddhist building, there are Corinthian capitals and pilasters, as well as a frieze and cornice, derived from the Greek. In the Yuzufzai sculptures numerous details may be found all bearing the same character.

I have already alluded to these sculptures as being in the Lahore Museum, and I may take the liberty here of again calling attention to their value. Some museums have unique collections, such as the Hermitage at St. Petersburgh, containing the splendid remains found in the tumuli, in the neighbourhood of Kertch, and the museum at Naples, which is now famous as the depository of all the objects resulting from the explorations of Pompeii. The Lahore Museum cannot vie with such establishments, and yet it resembles them so

far that it also is unique in being the only collection containing the objects which bear evidence of the existence of Persian and Greek art in India. No attempt can be made now at a history of art in that part of the world without dealing with this subject, and the collection is as far away as Lahore. I visited that museum in June last, and was so impressed with the importance of having at least casts of the objects brought home, that I wrote a letter on the subject, when I returned, to the *Times*, which was then published. I now mention the matter here, before the Society of Arts, feeling sure that whatever they can do to forward this much to be desired object, will be done.

On the walls will be found photographs of some of these sculptures, and you may judge for yourselves of their great importance to our art knowledge.

On the topes in the Jellalabad Valley, among those not quite reduced to the condition of mounds, and with remains of their architecture on them, the Greek influence is, I may state, very distinctly marked. The capitals are, as far as I could judge by what is left of them, all Corinthian—at least I came on no others, excepting those of Persian origin. The usual design for the more ornamental topes is for the square base to have a series of Corinthian pilasters, with base mouldings and friezes. On the circular part of the structure comes a belt of pilasters, also Corinthian, with a frieze above them; above this is another belt of pilasters, with an arch between each pilaster. The pilasters in this case are formed by two pilasters, the one being in the position of a base to the other. The lower one is Corinthian, the capital being surmounted with an elongated bracket, from which the arches spring. On the centre of the bracket, between the two arches, rests a narrow half-pillar, on which the Persian bell-shaped capital is formed, and above the capital is the member which should be ornamented with the two bulls; above that is another frieze. Close on this is a string of brackets, with a cornice, the whole of this last projecting beyond the cornice beneath it. The monument above this is plain up to the spring of the dome. I can only say that on those I saw there were no more pilasters or mouldings. The whole of this was thickly coated with plaster—remains of which still exist—and coloured ornamentation was added. As stated by the Chinese pilgrims, gold was also used for decoration, and I found some minute remains of it in one of my explorations. Hiouen-Thsang mentions one tope as having a dome covered with copper gilt.

Regarding the monasteries, I can say very little, for scarce a vestige of them now remains. Here and there a fragment of wall can be seen among the mounds. We can only judge—or I ought to say guess—of the architecture of them from the sculptures.

I have mentioned an arch as forming part of the decorative details of the topes. I will now deal with this in connection with the caves, of which there are such numbers in Afghanistan. At Bamian, about a hundred miles to the north of Kabul, there is what may be termed a city of caverns. At Chicknoor, near Basawul, one march beyond Daka, there is a very large group of caves, which I visited. At Hada, and at almost all the groups of topes in the Jellalabad Valley, there are numerous caves associated with them. These caves are now used in the winter as habitations by a nomadic tribe, called Koochis, who come down with their flocks from the north, returning again in summer. From this cause the caves are covered with dirt and smoky deposit. In many of them a thick coating of plaster is found, and there are very few in which some fragments of this are not left. That they were decorated with colour we may conclude, for at Hada there is a group of small caves which have suffered less from the smoke of fires than others, and on the plaster of them, traces of decoration are visible. Enough is left to distinguish panels, in rows, with heads of Buddha or Buddhist saints, with the Nimbus. In one very small cave, its smallness having saved it from the effects of smoke, the condition of the colour is about as fresh as when first put on; in this is a sitting figure, but from a damage in the plaster the upper half of it is gone, still the lower half, with a portion of the chair and footstool, is complete, and I have no hesitation in ascribing the style of art to Buddhism.

Nearly all these caves, as a rule, are about the same size. They are merely arched recesses in the rock, somewhere about 12 feet high, and the same in width. They vary a little, but if I say they are about 20 feet long, you will get a fair average idea of their general dimensions. A few have ramifications, but these are exceptions, and in no case are they of great extent. The arch form, I believe, came from India. At Barabar, near Buddha Gaya, there are some caves with arched roofs, and which were excavated as cells for Buddhist hermits; as the Afghanistan caves bear a stronger resemblance to these than to the rock-cut caves of Western India, I am inclined to accept them as the type which was followed in Afghanistan. The arched form of roof in this case I should be inclined to say originated in following the wooden form of the Buddhist Chaitya Temple, the details of which we know so thoroughly from those cut in the rock, and of which the caves at Karli and Ajunta may be mentioned as good examples. In the latter, the circular roof gives the shape of an opening at the end to let in light. This opening is therefore arched also in form, and is usually a little stilted, and slightly horseshoe in character. A broad flat band is formed round this, on the external surface, which is peaked in the centre at the top, and turns out below at each of the corners. As the Greek pediment, which was originally the gable of a roof, a derivation similar to this arch, was repeated in later times as an ornamental feature over doors and windows; and even where there were neither doors nor windows, merely as a decorative form; so this horseshoe arch in India went through exactly the same steps—from being in its origin a constructive form, till it was repeated in later times as an ornament; it may also be traced in this character in a multiplicity of shapes down through most of the Hindu architecture of later times. This arch is found occupying a very prominent place in the Yuzufzai sculptures, where it is principally decorative, and the arch I have referred to on the topes in the Jellalabad Valley is exactly a repetition of the same.

You will thus perceive what a strangely compo-

site character belonged to the architecture of the Buddhist period in Afghanistan. It had received a capital from Persia; a Corinthian capital, with frieze and mouldings from Greece; and an arch from India. It was at Venice that the architecture of Western Europe met, and combined with the Eastern style of Byzantium. Afghanistan, although widely separated, and vastly different in many respects, has yet some points of resemblance to the city on the sea. It was a trade route, and also a gate of conquest. These conditions brought together the art of Western with that of Eastern Asia, and combined them into one. To what degree of development this art reached I cannot as yet pretend to determine. As I have already said, there remains little but heaps and mounds, and the little I found during the short time I carried on explorations was so small that I have only ventured to call them "Art Vestiges in Afghanistan."

Among the few sculptures I found, some of them indicated that this branch of art had reached a considerable degree of progress. I need scarcely state that the Greek influence could be easily traced in it, not only in the pose of the figures, but in the treatment of draperies as well. In the sculptures we have also some valuable details of the domestic architecture of the period; and here I may be allowed to express the hope that further explorations will be made in Afghanistan. At Hada, about five miles south of Jellalabad, there is about a mile of mounds, the remains of an old Buddhist city, which is mentioned by the Chinese pilgrims. Except the holes driven into the topes by Masson, some 30 years ago, in order to get coins, nothing has been done to explore the mounds for the remains of the art and architecture they may contain. In a very small excavation made while I was there, the mound dug into was found to be composed of earth, stones, and a very large quantity of plaster figures, as well as bas-reliefs. The quantity of these was so great that it excited the wonder of all who visited the spot. You can judge for yourselves of the art from a few of these objects which are placed here for your inspection to-night.

At Darunta, which is at the west corner of the Jellalabad Valley, there is a very large and remarkable group of caves. The rock above had monasteries and topes of an extensive character upon it. One of these topes still retains some details of its architecture, as well as fragments of plaster. The natives now call it the "Pheel Khana Tope," from a large rock-cut cave, which they say was used at one time for keeping elephants in. The most interesting of the caves are in a perpendicular cliff, overhanging the Kabul River. At one end of them is a large recess, which I take to have been a niche. It is about 30 feet high, and here, I suppose, was a colossal figure of Buddha, but not a vestige of it remains. The figure, if I might make a guess from the proportions of the niche, may have been a sitting one. Higher still, above the ruined tope, is another niche of much smaller dimensions, and this I take to have been for a standing figure. I was led to the supposition of the purpose of these niches from their being so different from the usual form and arrangement of caves, and also from what we know of the colossal figures at Bamian, where recesses were cut into the rock with statues in them, one of which is said to be 120 feet high, and another of 70 feet.

We have every reason to suppose that these gigantic sculptures at Bamian which have been alluded to are Buddhist, but, unfortunately, up to the present time, we have no sketches of them sufficiently carefully made to form anything like a safe judgment. When lately in Afghanistan I used every endeavour to get on to Bamian, but the political situation made the efforts hopeless. In the caves at that place, which we may suppose were the viharas of the Buddhist monks, Lady Sale, in her "Journal" mentions the existence of fresco paintings, of which I have already mentioned some at Hada. Hiouen-Thsang describes a sleeping Buddha 1,000 feet long, at the same place, which he saw while passing through on his route to India. There is a long mass of rock extending along the ground near to Bamian, which the people look upon now as a dragon, or serpent, and in which Colonel Yule considers he has identified the remains of the old Buddhist monument. Although the vestiges have in this case changed their reputed character, an event not unusual in countries with a marked tendency to legend, I should feel inclined to accept the identification. Colonel Yule asked me, when starting for Afghanistan, that if I chanced to go as far as Bamian, to look out for the remains of this interesting relic of the past, but as already mentioned, I regret to say this was out of my power.

There is another region which I should also have liked to visit, and that is Kaffiristan. Those of my hearers who are familiar with this part of the world, will be aware that, as yet, Kaffiristan is an unknown part of the earth's surface. The one or two Europeans who have ventured to enter the country have, as yet, only failure to record as the result. The only knowledge we possess is derived from the evidence of natives. For a long time there existed a belief that the people who inhabit Kaffiristan were of a Greek origin, the descendants of those who came to that quarter at the time of Alexander. I understand that the inquiries regarding their language have resulted in dissipating this theory. The conclusion is that their language is of Sanscrit derivation, and that the race most probably belongs to that of the Hindus, who dwelt in Afghanistan not only before the Mahommedan, but also before the Buddhist conversion. It is a mountain country, on the lower slopes of the Hindu Kush. This need not have saved them from the Buddhist missionaries, but we know it has saved them from Mahommedan conquest. We also know that inaccessible highland ranges change but slowly; that old faiths as well as customs, which are swept away by invasions on more level regions, escape such liabilities in their mountain strongholds. From this it will be understood how great an interest has become attached to Kaffiristan and its exploration. Buddhism must have transmuted or swept away much of the older faith of Afghanistan, and Mahommedanism completed the work of destruction. From these considerations, it might be hoped that some of the vestiges of the past may yet be found among this primitive people, who have dwelt away secure from conquest and the causes of change. We need not suppose that the

condition of a people dwelling among mountains would be exactly the same as their neighbours on the plains. That which isolates them, and secures their independence, at the same time prevents their reaching the same degree of advanced development which is possible with the others. Still we know that there is some affinity always existing in the ideas and habits of mankind, when thus nearly situated together. Hence, although we might not obtain much that would tell us what the character of art and architecture of Afghanistan previous to the Buddhist period was like, yet that little would be peculiarly valuable. We know, from the monuments yet existing, that the architecture of India at the time of Asoka was a copy in stone of a pre-existing wooden manner of construction, which was no doubt the pre-Buddhist style of architecture. We now know this style even to some of its minute details, and in the architecture of the Himalayas we find some most valuable information from its existing manner of building, which throws light on the ancient styles of the plains. This early wooden style extended most probably, not only all over India and the Himalayas, but also as far as Afghanistan. Although this style might have much that was similar over this wide extent, yet it would have also, most probably, marked points of divergence in each locality. In the details of the Burmese architecture, which may be looked upon as the southern branch of this original wooden style, we can see yet remaining many identities with the period of Asoka. Seeing how wide branching this original architecture was, I feel confident that it extended to the Indus, and across it, at least as far as the Hindu Kush, and that it was the manner of building before the Greek and Persian styles came, and made their successful invasions upon it. I have sketches of one bit of detail from Afghanistan; it is not now constructive, but has been so in its origin, and, like the horse-shoe arch, it is found in Afghanistan at the present day only in a decorative form. From its appearance in this capacity, I should say it has been originally a door; the sides slope inwards towards the top, and it is surmounted by a horizontal member, with a cornice over it. We have nothing like it in the features of the Persepolitan or Greek styles as found in India, and there is no reason to suppose that it was brought with them. This trabeate construction is marked and distinct from the circular style of Asoka's time, but it must have been an important form, for in the Yuzufzai sculptures and in the Afghanistan remains it appears very frequently, and it is often repeated alternately as a decorative object with the round arch. The guess which I should make about it would be, that it is also the repetition of a wooden form, and that it was a variety from the wooden arch, and belonged to the same style, and most probably was a local characteristic of the northern region. I am inclined to suppose that these sloping jambs and the horizontal beam gives us the form of the doors and windows of the wooden construction in the direction of the Indus previous to the arrival of foreign influences from Western Asia. That this was a wooden construction I feel sure, and can point to the evidence of it, which I was fortunate enough to find. Although, as already stated, it only appears now as a decorative detail, yet in that capacity there is one point which has been retained in its repetition, and which is enough in itself to establish this part of its origin. This is, that the ends of the wooden beam forming the top of the door extends beyond the outside of the supports, and this has been faithfully copied and preserved in the representations of it which yet remain. If this was the form, as here suggested, of the doors in the countries bordering on the Indus, the probability is that the roofs of the houses were flat. The arched form of the caves in Afghanistan, I take it, came from those of Buddha Gaya, but at Hada I noticed one or two caves in which the roof was flat, and this, although an exception to the usual mode, may have been a following of their own manner. The caves, as a rule, sloped inwardly to the top, and whether this was keeping to the style of their own sloping doors, or came from India, where we know that it exists in some of the Buddhist caves, as at Bhaja, and the Lomas Rishi cave, would be a point rather too fine to speak of with much certainty.

If we had details of the temples and buildings in Kaffiristan, perhaps light might be thrown on the questions I have touched upon. We know that these people construct their houses with many stories, and that wood, if not the only material used, is largely employed, and is elaborately carved. They have separate houses for their temples, and the figures of their gods are made of stone. They have gods named Mahadeo, Pané, Truskin, and Imra—supposed to be the Vedic Indra—but their chief God, of whom all the others are only forms, is Dogan, a name suggesting the Hebrew or Akkadian Dagon. They bury their dead in coffins, and cut a notch on a wooden stick, placed at the head of the grave, for every man the defunct has slain in battle.

I shall now give you a very slight account of the excavations I made at the Ahin Posh tope, near Jellalabad. The late Sir Louis Cavagnari provided a working party from the villages around, and a havildar, named Kalah Khan, of the Queen's Own Corps of Guides, acted as overseer. It was supposed that Masson had left none of the topes in the Jellalabad Valley untouched; but, although he had opened the greater part, he left, I am glad to say, some for others to work upon. He seems, from his writings, to have made a distinction between topes and tumuli, and, as the Ahin Posh tope was only a mere heap, it escaped from his operations on that account. The present name of this monument is curious. I may remark that all, or nearly all, the Buddhist names have disappeared, and have been superseded by those given by the Mahommedans. The words Ahin Posh are Persian, and are rendered as "iron clothed," or "iron clad." The people of Kaffiristan, as an example of the word, are called by the Afghans the Siah Posh, or "black clothed." This illustration of the language will make you understand the guess which has been made, that some chief in later times, who had occupied the spot as his castle, had worn armour, and that the name of "iron clothed" had become at last transferred from him to the locality. Over the Buddhist masonry are the remains of later walls, which show that the place had been occupied after the Buddhist period, giving thus a basis for the origin here made in regard to the words. I regret to say that nothing was left of the Ahin Posh tope but the lower part of the square

base. There was only a small portion remaining of the first course of masonry of the circular part of the tope. This was so far lucky, because it was sufficient to give the measurement of that part of the structure, which was 80 feet in diameter. The accumulation of earth and stones was dug out all round the square base, so as to get an accurate plan of the whole, as well as sections of the mouldings. The base was 100 feet square, and was ornamented with Corinthian pilasters. I found that there had been a stair of approach on all four sides, but two of the stairs did not belong to the original design; at first, when the tope was erected, there were stairs only on its north and south faces. There had been an enclosure all round the tope, forming a courtyard about 500 feet square. Through this the principal gateway entered from the south, in a line with the original stairs on the south and north side of the tope. This approach had evidently, from its plan, been an important construction. There was further evidence of what it had been in the remains of colossal figures, which were brought to light. You may judge of their size from two beautifully modelled feet, 23 inches long, in plaster, which were all that remained of the statue they belonged to. We hoped to have saved these for the Lahore Museum, but they fell to pieces during the excavations. They were standing figures, and faced those who entered. I fancy this propylon was built in some way like a house—like the noubut-kana of a palace or temple in India. To the west of the tope was a great mass of ridges and mounds, the remains of the vihara, or monastery, the whole forming one large establishment. I regret to say that, although strongly desiring to explore the whole of the mounds, time did not permit me to do so.

While the work was going on around the tope, a tunnel was being dug into its centre. The external wall was of stones and slate, the stones being placed at regular intervals, and surrounded by layers of slate, producing a diaper or checkered pattern. This style of masonry is peculiar to all the remains of the Buddhist period in Afghanistan. The tope itself, within this outer skin, is a mass of water-worn boulders embedded in mud. The tunnel had to be made high enough for the men to walk erect carrying out the stones. As it had to be driven through part of the square base, its whole length to the centre was about 45 feet. I was fortunate enough to come direct upon the cell, which was formed of layers of slate, and was a perfect cube of 16 inches. In this small repository, which constituted the sanctum, in honour of which the whole monument had been raised, and to which the ritualistic ceremonies of the Buddhists were directed, I found two handfuls of dark-looking dust, which I take to have been part of the ashes of some noted holy man of the time, deposited after cremation, which was the rule of the Buddhist priesthood. On the top of the ashes lay a golden relic-holder. It was octagonal in form, about four inches long, and set on each of its faces with stones. Among the ashes were twenty gold coins. The relic-holder and the coins had no doubt been deposited as offerings along with the ashes at the consecration ceremony of the shrine. This was the custom, as we learn from the Mahawanso of the Buddhists in Ceylon. The coins were about two drachms each in weight, and about the size of a sovereign. Seventeen were Bactrian or Indo-Scythian, and three were Roman. The Indo-Scythian belonged to the reigns of Kadphises, Kanerki, and Hverki, dating at the end of the century before, and the first century of the Christian era. The Roman pieces belonged to the reign of Domitian, Trajan, and the Empress of Hadrian—that is the end of the first and beginning of the second century. These coins were all in beautiful condition. The bust of Trajan is a very good likeness, that is, judging from the usual portraits of the emperor. One of the Indo-Scythian coins is said to be unique. It has on it a figure of the preaching Buddha, and the name BOΔΔO, or Buddha, in Greek letters. As the terms arranged with Major Cavagnari were that all coins or sculptures found would belong to the Government, I handed everything over to him, and they were sent to Lord Lytton, the Viceroy, at Calcutta. I understand the coins will be distributed between the collections in Calcutta and the India House here, according as they may fill up gaps in each.

The coins are only a negative evidence towards the date of the tope. From them it is certain that the tope is not older than the second century A.D. How much later it may be is rather a difficult question as yet to determine. Further research is required. I believe that coins were not placed in topes as offerings till they had ceased to pass as current money, that is, till they had become rare, and were looked upon, perhaps, as curios, or as charms, so that they probably were not placed in the Ahin Posh tope until perhaps two or three centuries later than their dates; this supposition would bring us down to about 400 or 500 A.D. I would suggest these dates as a tolerably near approximation—at least, it will do till we get further light on the remains of the Jellalabad Valley, and are able to come to a more exact conclusion.

The Roman coins throw light on Afghanistan as an old trade route, for it is mainly by supposition, founded on this character of the country, that we can explain the existence of these pieces of money in the Jellalabad Valley. Hiouen-Thsang, the Buddhist Pilgrim, came west from China by the old beaten route, and then turned south into India through Afghanistan. This, as well as the Roman coins, show that Afghanistan was the way of commerce from Central Asia into India at that distant date. The tolls, or "black mail," which the Khyberies and other tribes still demand, are the evidences of a continuation of this character which has existed at a very early period. I may also point out that the great extent of the Buddhist remains tell us in very clear language of a larger population in the past than at present. The architecture and art of the time are proof in themselves of a culture and civilisation which is not to be found in the country at this day. The structures I have described, ornamented with sculpture, with colour, bright with gold and precious stones, speak of a wealth which has long ceased to be found in the valleys of Afghanistan. Our engineers came upon fragments of aqueducts, formed of the well-known "Buddhist masonry," which, judging from their direction, led water, at a former period, to plains which are now stony deserts. By thus showing you what the country was, you

may know what it is capable of, if it were under a more settled system of Government; and by this teaching I hope you will have derived, at least, some small amount of knowledge from the "Art Vestiges in Afghanistan."

DISCUSSION.

The Chairman, in inviting discussion, said he did not profess any scientific knowledge of this subject, but he had some knowledge of the localities mentioned, and he must say he had been particularly struck with one or two points referred to in the paper. In the first place, with regard to the origin of the topes, or the purpose for which they were constructed, Mr. Simpson spoke of them as being essentially tombs, and stated that the form was that of a plinth, over which there was a dome, very much in the form of what in India would be called an inverted "gurrah," or pipkin. In his travels in Ladak and Thibet, he came across numbers of these "chortens" which had been referred to, and which were very similar to the topes discovered in the Jellalabad Valley, only the gurrah or pipkin seemed squashed down and made rather flat at the top. When he crossed over into the Yarkand country, and went to Kashgar and the country to the north, and on to the plains where the Khirgis had fed their flocks for centuries, and, it might almost be said, had hardly changed their customs from the day when they came out of the ark, he one day came across a burial ground, and found a large number of extraordinary tombs. The base was a kind of plinth, quite plain, but what struck him as most remarkable, was that the superstructure was exactly of the shape of the tents in which the Khirgis lived. It seemed to him at the time that when a chief or a priest was buried, it had been the intention to reproduce the same kind of tent in which he had lived, thus making a permanent resting place for his bones after death. Mr. Simpson's remarks showed, he thought, that there was some analogy between this case and that of the topes at Jellalabad. Again, with regard to the caves, those who had been to India had heard a great deal about the caves in Bamian and other places; and across the mountains, in the direction of the Tien Shan range, there were some wonderful caves, that he hoped would one day be explored. The people in the Kashgar country spoke of one particularly remarkable cave, in which there was a wonderful image, which rolled its eyes and moved its tongue when visitors went too near; and he hoped that before long these caves would be explored by some one as enterprising and skilful as Mr. Simpson.

Colonel Yule, C.B., said it was very pleasant indeed to find a man like Mr. Simpson, who had the gift of painting, who had also the gift of applying his brains to other subjects, and could make his paintings illustrate subjects in which he took an interest. Thirty or forty years ago, the subject of Buddhism and Buddhist architecture, and the many branches into which it had spread, was scarcely known. The information we now had was mainly owing to the labours of three or four of our own countrymen, such as Mr. Fergusson, and General Cunningham, and Mr. Simpson was rapidly taking his place among them as one of our greatest enlighteners on this subject. He did not quite know what to say on the theory started by the Chairman as to the tope being possibly derived from a Tartar tent; but he did not think it was necessary, because the tope, in its simplest form of a half-sphere, or beehive, was just like a tumulus, which had been used for the graves of chieftains from time immemorial, all over the great plains of Central Asia, so that it did not require much imagination to conceive of that tumulus of earth or stone being converted into an architectural structure; just as, on the other hand, the wooden hut had been converted into the elaborate Greek temple. He had sometimes seen it stated that Buddhism came from the north, because these topes or tumuli seemed to have originated in the great plains of Central Asia, but he did not think there was any evidence for this notion. All the evidence seemed to be that Buddhism, with its elaborate religion, architecture, and philosophy, spread from India; and the Valley of Jellalabad, and the Cabul river was really, until the Afghans became predominant, part of India. India formerly extended to Cabul, and Alexander, when he came to the Cabul Valley, considered that he had entered India. It appeared, then, that some centuries before our era, Buddhism spread up through this Cabul Valley, and the various conquerors who occupied that country and the basin of the Oxus all seemed to have adopted it, as could be seen from the remains at Bamian. As yet these remains were almost all they knew of in the locality, but they might hope that when they knew more of the upper part of the Oxus Valley, much might be discovered there. The paper referred to the Chinese pilgrims who came by that route, and it showed the tremendous barrier that separated India from China, that the earliest knowledge which the Chinese had of India was not derived by the short line of two or three hundred miles which separated the two countries, but through the Valley of the Oxus. Along that line, also, Buddhism seemed to have propagated itself. It was very striking to the imagination to see how this Indian influence had extended; traces of Indian religion and Indian names were found as far as Lake Lob, which there could hardly be any doubt was a Sanskrit name. Again, the old historians of the conquest of Turkistan, in speaking of Bokhara, said it was a place of learning, and that its name meant in the language of the heathen, "a place of learning." He thought there could hardly be any doubt that the name was Vihara, or monastery of Buddhists. Buddhism also spread far to the east and south-west, to say nothing of China and Thibet. Mr. Simpson had spoken of the "chortens" of Thibet as having the form peculiar, as he considered, to the right bank of the Indus; and that must be historically confirmed, because Thibet was said to have derived its Buddhism not directly from India, but from Peshawer and the Swat Valley, now filled with ferocious and half barbarian tribes, where once civilised cities and learned communities had their seat. Buddhism was also found in Burmah, Siam, Cambodia, whose wonderful temples had lately been explored by a French traveller, in Java, and even so far as Borneo.

General Maclagan, R.E., said that everyone who had been interested in the subject of Indian antiquities, and all those who had resided for any time in the north-west part of India, must feel greatly indebted to Mr. Simpson for the addition he had made to their information. As yet we had not obtained any certain knowledge of the origin and history of these buildings, but it was most important that we should be constantly adding to our information with reference to them. No doubt there would be a great difference of opinion with reference to the views held by different explorers, but the more knowledge we obtained the more would these differences disappear. With reference to the remark that the number of topes surrounded with buildings in different parts seemed to indicate a very large population, he believed it was scarcely doubted now that the topes were not necessarily connected with monasteries, although no doubt many of them were in the ruins which it was believed marked the site of the ancient city of Taxila. There were remains of no less than fifty-eight topes, surrounded by remains of other buildings, and this city was very large and important at the time of Alexander, for there were found not only the remains he had mentioned, but various other buildings of unmistakeably Greek origin. The most perfect of the Greek bases now in the museum at Lahore, and portions of a shaft and capital, were all found at the place.

Again, at the interesting ruins of Takht-i-Bahi, to which Mr. Simpson had referred, there were remains of topes and extensive buildings, which were believed to be the remains of a city and not merely of a monastery. These remains had as yet been very imperfectly excavated, though an endeavour had been made for several seasons past to carry on the work systematically; but a great deal still remained to be done, and they might hope for very interesting results. The workers, now proceeding year by year, had, no doubt, much more information, which would soon be forthcoming, but it was very desirable that the work should be carried on by artists so accomplished, and observers so accurate, as Mr. Simpson.

Mr. R. N. Cust asked if any inscription had been found in any of the remains which had been examined? Most interesting inscriptions had been found in the Buddhist memorials, in different parts of India, showing ancient forms of Greek words, from the time of Alexander to the first century A.D., and also the form of language spoken at that time.

Lieutenant Bartram, R.E., being called upon to speak, said that all he knew of the Buddhist remains in the Jellalabad Valley he had learnt from Mr. Simpson, and all he could say was that he would bear testimony to the thoroughness and energy with which he had carried on the operations.

Mr. C. Cooke said he had lately noticed in the *Builder* of the 29th November an engraving of one of the topes referred to.

Mr. John Jones asked it were certain that the Greek influence found in some Indian architecture was due to the invasion of Alexander, or was it earlier? In Xenophon's "Retreat of the Ten Thousand" there was mention made that the Persian king had a Greek physician in his employ, and it seemed to him just as likely that he had a Greek architect. In fact, his command over all the Greek colonies on the Mediterranean coast would very likely give a good opportunity to professional men in the Greek colonies to get into the service of the great Persian Emperor, and it seemed possible that the influence was earlier than the time of Alexander.

Mr. Simpson, in reply, said of course he had no further information with regard to Greek influence on India than could be obtained from the ordinary sources of history. But it was not necessary to suppose that Alexander had architects with him at all, though of course he might have had. It was a Greek influence he referred to; not that you were to expect to find Greek buildings, but rather Indian buildings with Greek details, differing much from the original Greek. And it was supposed to have come into India after the time of Alexander. Greek cities existed in Cabul, and there was even supposed to be one in the Jellalabad Valley; and many Greek coins had been found in that part of the world. The influence of Greece on architecture came down as far South as the Punjaub, but whether that was the limit was a point which required further investigation. He had a notion that some little of it might be be traced as far as Muttra, but to a certainty it was found at the site of the ancient Tixila, and up in Kashgar. In talking of Greek influence, they took Alexander as a starting point, but he did not suppose Alexander had anything to do with it; it came down from the Bactrian provinces to the north-west. In reply to Mr. Cust, he must express his great regret that there were no inscriptions discovered. He carefully inspected all the slates that formed the cell, making a second visit for the express purpose; but beyond a bit of stone, which had something on it, which might have been a letter, he did not see anything. Probably there might have been painted inscriptions on the plaster, and the inside of the caves the same, on which the inscriptions were painted, not cut. With regard to the Chairman's explanation of Kirghis tombs, it was quite possible that the Khirgis did make them in imitation of their tents, because the old idea of a tomb was that it was the long home to which all had to return. In the Vatican Museum there were models of ancient Etruscan vases for holding the ashes, with sloping tops, made in imitation of ancient huts; but he did not think this was the origin of the topes. Colonel Yule had given no doubt the the correct theory, that the tope grew out of the cairn. The mound came first, then the cairn, and then the tope. You might suppose the primitive man digging a hole to put a body in, and the earth being displaced, there would be a mound. In the case of distinguished people, this would be increased until you got to great mounds and barrows. The next stage would be to put circles of stone round. In the Jellalabad Valley of the present day, the tombs consisted simply of a mound with a stone at the head and foot, the stones being placed differently to indicate whether a man or woman was buried there. In the imperial tombs near Pekin, there was simply a mound half a mile in circumference; and a wall built round it, forming as it were half a tope. In China, at the present day, the ordinary grave was simply a mound. These matters, like the stone and the iron ages, dovetailed into each other; there was no sharp line of demarcation. In his opinion the seven terraced towers of the Euphrates Valley, and the pyramids of Egypt all sprang from the same source, though he could not say there was as yet direct evidence to prove it.

Colonel Yule said, in reply to Mr. Jones, that there was no mystery about Greek architecture in India. It did not arise from some wandering Greek architect, but after the time of Alexander his kingdom was divided, and out of it arose the Greek kingdom of Bactria, where there were Greek kings and Greek names, such as Menander, Euergetes, &c. These kings coined Greek money, with Greek inscriptions, and by degrees this Greek knowledge became diffused, and other coins were struck, but the Greek letters became gradually debased and barbarised. The same thing occurred with architecture; it gradually lapsed into what was seen there, until all traces of Greek art were lost.

The Chairman said he would not venture to assume for his Khirgis friends that they had taught the Buddhists how to build their topes; it only struck him as the Khirgis were a very conservative people, who brought their customs down from long ages, and as Mr. Simpson had remarked that these topes were tombs, that this idea of copying a tent might have been caught by them originally. He begged leave to propose a cordial vote of thanks to Mr. Simpson, who had made one very practical suggestion with regard to the museum at Lahore. It would, of course, be impossible to take the collection away from there, but something might be done towards bringing casts of various objects to England. In his concluding remarks, Mr. Simpson suggested that Romsn coins threw a light on Afghanistan as an old trade route. That they all knew, but his suggestion evidently was that at the present time when all thoughts were directed towards Afghanistan, there were hopes that trade yet might revive, and it was very interesting to know of the traces of the existence of a much larger population in these parts than existed at the present time. Population without the means of subsistence was not exactly to be desired, and he remembered that Dost Mahomed, many years ago, spoke of his country as possessing nothing but men and stones. Mr. Simpson now told them there were traces of old aqueducts, which showed that there must have been at one time a very extensive and well-arranged system of irrigation, and with that a very large cultivation; therefore they might hope that as peace and civilisation spread in those parts, the country instead of being one possessing only men and stones, would bring a great deal of

trade into India and become flourishing and well populated.

General Maclagan desired to add a word with regard to the Lahore Museum. The idea of sending the sculptures home to England had been considered, but it was not deemed advisable to do so, but rather to take casts and photographs for that purpose. The first casts made were brought home by Sir Bartle Frere, and since then about sixteen or seventeen more had been completed, which he saw when there a few months ago.

The vote of thanks was carried unanimously, and the meeting adjourned.

MISCELLANEOUS.

IMPROVED LIGHTS FOR LIGHTHOUSES.

Sir William Thomson, F.R.S., whose attention has been for many years directed to the question of improving lighthouse lights, writes to the *Times* to urge a three-fold reform in our lighthouse system, viz., "A great quickening of nearly all revolving lights; the application of a group of dot-dash eclipses to every fixed light; and the abolition of colour as a distinction of lighthouse lights, except for showing dangers and channels and ports by red and white and green sectors. Of about 120 revolving lights on the English, Scottish, and Irish coasts, there are in all 18 in which the periods are ten seconds or less, and the times of extinction seven seconds or less. In these quick revolving lights the place of the light is not practically lost in the short intervals of darkness; the eye sweeping deliberately along the horizon, with or without the aid of a binocular, to 'pick up the light,' passes over less than the breadth of its own field of view in the period of the light, and thus picks it up almost as surely and quickly as if it were a fixed light. And so in respect to compass bearings, whether taken roughly and quickly by inspection or more accurately by azimuth compass, the bearing of the ten-second or quicker revolving lights is taken almost as easily and accurately as if the light were continuous."

Sir William Thomson then gives the results of some experiments made by him during a ten days' cruise on board H.M.S. *Northampton*:—"The Wolf, a half-minute light, is interesting particularly as showing red and white flashes alternately, with a very perfect equalisation of intensity of the two flashes, which is quite a triumph of optical science and skill. We had ample opportunities of comparing the Eddystone (fixed light) with the Start in respect to ease of taking their compass bearings. The great contrast between them in this respect renders the Eddystone practically a much more valuable aid to navigation than the Start. The first picking up of the Eddystone contrasted very favourably with our experience in this respect of the Wolf. The Eddystone was picked up and its compass bearing taken by inspection to less than a quarter of a point, when the light was so faint on the horizon that it could scarcely be seen, or not seen at all without a little motion of the eye to refresh its sensibility. The Wolf could not be seen at all, or if seen for an instant would be lost again for many of its reappearances, until it was very much brighter than the Eddystone had been when it was effectively picked up and used. When the Wolf did come well into view, bright enough to let no flash be lost, I was agreeably surprised by the ease with which its compass bearing could be taken with all needful accuracy, and I had almost come to the conclusion that the half-minute was quick enough; but, alas! I soon found that the convenient quickness was a temporary irregularity, and that when the light seemed almost satisfactory in point of speed it was making its period more nearly a quarter of a minute than half a minute. To ascertain the truth I observed the light carefully for 15 periods, writing down the hour, minute, and second of the beginning and end of each flash. The successive periods, each stated in seconds, were 40, 35, 27, 33, 32, 32, 32, 30, 29, 26, 25, 26, 25, 19, 23, of which the least is 19, the greatest 40, and the mean 28·9. The times of darkness were 28, 24, 19, 27, 23, 23, 23, 20, 20, 19, 18, 19, 17, 13, 16, of which the least is 13, the greatest 28, and the mean 20·27. This was from 6.40 to 6.50 on the evening of the 8th of November. To find whether the irregularity was only temporary and exceptional, I observed again on the following evening, commencing this time a few minutes after 10 o'clock, and observing 24 periods successively, with a mean result of 23·7. It is clear that the Wolf light wants a good centrifugal governor. The distinctive value of a definite period in a revolving light is almost annulled by such irregularities as these. In fact, a serious case of mistaking the Wolf for the St. Agnes (Scilly Islands), a minute-light, has been reported. The mistake was attributed to the Wolf having been seemingly converted from a half-minute to a minute light by its white flashes being lost, because, with equal effective intensity at a short distance, the white light is less effectively intense through a great distance of hazy air than the red light. But it is quite possible that the mistake may have been due to the Wolf mechanism having had a fit of extra slowness on the occasion. I can myself testify to a case in which it was simply impossible to distinguish revolving lights by their periods. In 1877, sailing along the Spanish coast bound for Vigo, I had for an hour or two three revolving lights all in sight at the same time—Salvora Island, "white with red flash every two minutes;" Ons, Pontevedra Bay, "white with flash every two minutes;" and Bayona, or Cies Islands (in the mouth of Vigo Bay), "white with flash every minute." It was absolutely impossible to distinguish the three lights according to the descriptions of them quoted as above from the Admiralty "List of Lights." But in later editions of the Admiralty "List of Lights," I see a warning of irregularity in respect of this same Bayona light, to the effect that in September, 1872, Captain Brandreth, R.N., in her Majesty's ship, *Lord Warden*, observed it to flash every half-minute.

Except in one unimportant case—the Dungeness Low Light, which flashes every five seconds—all the revolving lights of the English Channel are too slow, and it would be an unspeakable improvement if, with that exception, every one of them had its speed sextupled. There is no mechanical difficulty in the way of doing this. The triple-flash light of the Royal Sovereign Shoals Lightship is at present very admirable, and to a patient enough observer, with time enough to spare, it is thoroughly distinctive. But the 37 seconds of darkness is a serious defect of that light, and the slowness of the three flashes, occupying the remaining 23 seconds of the period, is an altogether unnecessary derogation from the distinctiveness of character which greater speed would give them. Three short flashes in three or four seconds, with an interval of six seconds of darkness, would have an instantly recognisable rhythm (letter S of the Morse flashing alphabet); and, when once descried, the light would be known to be what it is, and nothing else, even before the completion of two of its ten-seconds periods.

Revolving lights are, however, but a small minority of all the lighthouses of the world. Of the 623 lights of the British and Irish coasts, just 110 are revolving lights, and the remaining 513 are fixed, and there is a crying want of distinction for fixed lights. The distinction by colour alone ought to be prohibited for all lighthouse lights, on account of its liability to confusion

with ships' and steamers' side-lights. Southsea Castle, with its red and green port and starboard side-lights, seems as if actually planned to lure on to destruction an unsuspecting enemy carefully approaching the coast with Thomas Gray's happy rule well impressed on his mind:—

"Green to green, and red to red,
Perfect safety, go ahead."

He does so, and is wrecked on Southsea beach.

My proposal for supplying the want is to distinguish every fixed light by a rapid group of two or three dot-dash eclipses, the shorter, or dot, of about half a second duration, and the dash three times as long as the dot, with intervals of light of about half a second between the eclipses of the group, and of five or six seconds between the groups, so that in no case should the period be more than 10 or 12 seconds. This proposal has been carried into effect with perfect success in Holywood Bank Light, Belfast Lough, now the leading light for ships entering the Lough, but which until 1874 was enclosed in a red glass lantern and was only visible for five miles, and was constantly liable to be mistaken for a sailing vessel's port-side light entering or leaving the harbour of Belfast, or the crowded anchorage of Whitehouse Roads. In 1874 the red glass was removed, and the light was marked by dot, dot, dash (— — ———, or letter U), repeated every 10 or 12 seconds, and has been so ever since. It is now recognised with absolute certainty practically as soon as seen in ordinary weather from the mouth of the Lough, ten miles off, and has proved most serviceable as leading light for ships bound for Belfast or entering the Lough.

It is much to be desired that the dot-dash system should be seriously considered by the lighthouse authorities of our islands. It is satisfactory now to know that the Deputy Master of the Trinity Board, Sir Richard Collinson, K.C.B., has, after its character was correctly put before him by the recent Select Committee of the House of Commons on Electric Lighting, given it his approval in the concluding answers of his evidence.

Is it too much to hope that when the new Eddystone Lighthouse is finished the light shall not be, as hitherto, an undistinguished fixed light, but a fixed light distinguished by a group of dot-dash eclipses—such as dot, dash, dot (— ——— — letter R)—which is particularly easily distinguished by its rhythmical character; and the Needles Light, which shows red over a great area of sea south of it, and when undistinguished, as at present, is liable to be inconveniently and even dangerously mistaken for a ship's port-side light, shall have a distinctive dash, dot (——— — or letter N) given to it, which, whether in its red or in its white sections, will instantly show it to be itself and no other light at sea or on shore? The five years' practical demonstration of the dot-dash system in Belfast Lough ought surely to weigh with the authorities."

LIGNITE IN EASTERN EUROPE.

The varieties of brown coal, or lignite, are so unfavourably viewed by English engineers, in comparison with the black bituminous and stone coals with which our country is very richly supplied, that their great importance is apt to be under-rated amongst us. Throughout the middle and east of Europe they are practically the only resources available. They are found generally associated with clay, in tertiary basins, and the thickness of the lignite is often exceedingly great as compared with that of coal-seams. Deposits have been described in Nassau, near the Rhine, in Meiningen, one of the smaller Saxon States, and in some other parts of Germany. Others occur near Leghorn, in Italy, in Switzerland, and in Eastern Europe; but none have hitherto been worked to any great extent except in a narrow tertiary basin south of the mountain chain separating Saxony from Bohemia, and well known for the remarkable mineral springs utilised at Carlsbad, Teplitz, and Marienbad.

Lignites suffer in comparison with bituminous or true coal in two ways—they contain water, the evaporation of which reduces their calorific power; and, on exposure to weather, they break up into small particles, so that they cannot be stored. These objections are real and considerable, but not fatal. They involve a certain loss, compensated for by reduced price, and if the material can be supplied at a low cost price, it is perfectly available for all purposes of fuel. This is well exemplified by the fact that the Bohemian lignites meet coals from the Newcastle and Durham coal-fields carried by sea to Hamburg, and although subject to a railway and water transit of 350 miles, they compete so successfully that even in the year 1878, when English coals were at the lowest price, there were 12,200 tons conveyed from the Bohemian mines and sold at a profit.

These lignites were only of value locally till the railway system in Central Germany was tolerably complete, but they have long been utilised for manufacturing purposes. Seven years ago rather more than a million tons were extracted, a large proportion being taken by the numerous manufacturers of beetroot sugar and other matters that had risen up in Northern Bohemia. In 1878, upwards of four and a quarter millions of tons were carried to distant markets, over nearly sixty lines of railway, to 1,200 stations, in addition to the million tons still retained for local use. These figures are obtained from a statistical account published officially every year at Teplitz.* According to this statement, the coals are carried northwards to Berlin, (185 miles) and Stettin (290 miles), north-eastwards to Frankfort-on-the-Oder (110 miles) and Posen (220 miles), eastwards to Breslau (230 miles), south-eastwards to Vienna (300 miles), south-westwards to Munich (260 miles), and Stuttgart (300 miles), westwards to Cassel (300 miles), and north-westwards to Hanover (265 miles) and Hamburg (350 miles). A range of market so widely extended, coupled with the fact that the average annual increase of production since 1872 has been at the rate of more than 25 per cent., proves that this fuel, whatever may be its estimation with us, is not to be despised as a contribution to the supply required for the numerous towns and manufacturing interests of Germany and Austria, and must have considerable influence on the progress of manufactures in that part of Europe. The value of brown coal as fuel is, after all, not greatly below that of bituminous coals theoretically, and practically it is more useful than very good black coals in certain cases. In the first place, the proportion of ash is small, and the ash produces no clinkers. A fair average sample obtained from the crop of the coal some years ago, and analysed at the Royal School of Mines, in Jermyn-street, showed—Combustible matter, 79·85; water, 17·13; ash, 3·02; and its calorific power, as determined by Thomson's calorimeter, was 11·5. In the next place, the coal, even when weathered into very small lumps, will stand a blast, and can be used as smith's coal. It gives a long flame, and is particularly adapted for boilers, the feeding being very easy, and the ash never troublesome. It takes fire readily, and burns like wood, getting up steam quickly. It is a very useful gas coal, yielding from 6,000 to 7,000 cubic feet of gas per ton, and leaving bye-products of average value in quantity and quality, except coke, of which there is none. It can even be used for smelting, and is so employed in the great mining establishments of Przibram. The important question to be considered is the price at which it can be sold to profit, and this is determined chiefly by the facility and cheapness of

* "Statistik des Böhmischen Braunkohlen-Verkehrs im Jahre, 1878."

extraction. Belonging to a comparatively recent geological period, and being free from the innumerable and irregular disturbances to which, at least in England, bituminous coal has been subjected; deposited, too, in thick masses, compared with which coal-seams in our country are insignificant, and covered chiefly with clay not admitting water, and rarely more than a couple of hundred yards in thickness—all the conditions are favourable for cheap production. There are in the corn-field, as now opened, 132 shafts, few of them more than 100 yards to the coal, but none of size large enough to lift more than 500 tons per day, and the whole averaging less than 150 tons per day. The field is crossed by several lines of railway, but none of the owners of concessions having large capital at command, it has been the custom to sell the coal at the pit's mouth, and to do this with so many small proprietors, the competition has of late years been very sharp. The present selling price is quoted at 32 marks per truck of 10 tons (metrical), which is equivalent to a little more than 3s. per ton for the best screened coal of large pieces only (drawing-room coal). Of this kind the proportion raised is about 65 per cent. The broken pieces sell for 2s. 3d. to 1s. 6d. per ton, according to circumstances and size, and the small fetches only 6s. for the 10 tons. It is understood that the profit averages about 2s. per ton, and as there are no dues or royalties to pay, this enables the coalowner and collier—generally the same person—to live. Considering that the arrangements are very primitive both above and under ground, that human labour is used where mechanical contrivances might well be adopted, and that the coal is obtained by blasting, and is thus much wasted, although wedging would be easier and more economical, it would seem possible to work much more cheaply, and, by combining agency with coal-getting, larger quantities of coal might be sent to distant markets, yielding a much higher profit. The freight charged by the railways is comparatively high in Bohemia, but low in Germany. A considerable quantity is sent down the Elbe and up the Spree and other tributaries, and it is carried by water at very low rates.

The coal in the Bohemian coal-field is proved by borings in various places all over the district. The quantity is exceedingly large per acre, and there is every facility offered for rapid extraction. There is no fire-damp, and no fear of any, and hitherto the small amount of choke-damp has been even removed by ventilation. There is very little water. It would be perfectly easy to sink a pit capable of lifting 1,000 tons a day, and it could not be difficult to place almost any quantity in the various towns already partly supplied. The great drawback to the use of this fuel is the impossibility of keeping large stores of lump coal, and the quickness with which it falls to pieces from weathering. In other respects it is extremely convenient. It is clean to the touch, and, though not free from pyrites in the intervals of bedding and near the top of the deposit, is not loaded with sulphur in the bulk, and in many parts is quite free. There are no stone bands, and only here and there clay partings, in a thickness of compact coal which sometimes exceeds 100 feet. It burns without disagreeable odour, and is generally used as a house coal. Many of the towns of Bohemia are lighted with gas made from this coal. The gas is white and of high illuminating power, and compares well with the gas made from bituminous coal.—*Journal of Gas Lighting.*

MANNA PRODUCTION IN ITALY.*

The planting of Fraxinus trees in Italy yields pecuniarily a good return without any great trouble or cost being incurred. The best trees for planting are *Fraxinus Ornus*, L., and *F. excelsior*, L. The former species has been artificially introduced into Sicily and Calabria, though both species occur there growing wild.

When the tree has attained an age of eight to ten years it is used in the production of manna. For this purpose a horizontal incision is made in the bark with a sharp garden knife, equal to about one-fifth of the entire breadth. In doing this the following points are observed. In the first year the incisions are made upon the side of the tree towards which it inclines (the Fraxinus scarcely ever grows straight) and they always progress from below upwards. The first incision is made at the base of the tree, and then one incision over another at intervals of one centimetre until the ramification of the branches is reached. The incisions are then made on the opposite side, commencing at the base of the tree as before. From the beginning of July to the end of September an incision is made daily in each tree.

The manna is collected during nine years, when the tree becomes exhausted and incapable of production. For this reason during the ninth year incisions are made simultaneously on both sides of the tree in order to use it up completely. The tree is now cut down, leaving only a single shoot, which at the end of four or five years is capable of production.

The juice which flows only from the incisions is at first brownish, and has a bitterish taste; but after some hours in contact with air it becomes solid, whitish, and sweet, forming long pipes or small stalactites. But frequently the juice is very fluid, and it then runs down, forming a kind of long plaster that adheres to the bark, whilst a portion drops to the ground, where it is collected upon leaves of *Ficus Indica*.

The manna is collected once in the week, and only in fine weather; if rain falls the gathering is hastened. Rain and dew interfere with the profits. A man provided with two vessels goes round to the trees, collects the pipes and scrapes off the smooth mass lying on the surface, putting each sort into a different vessel, as in commerce they have a very different value. The first sort is the "manna canellata," the second "manna in sorta." After the collection both sorts are spread out in the sun to dry a little, and then sold.

The gross returns from a hectare of land is on the average 850·35 Italian francs, viz., manna canellata 6 kilos at 22·10 = 132·60; manna in sorta, 94 kilos at 7·50 = 705; wood cut down, 12·75. Total, 850·35 francs.

* Paper by J. Janssen, of Florence, in the "Agricoltina meridionale."

BERLIN INTERNATIONAL FISHERY EXHIBITION, 1880.

The King of Saxony has placed at the disposal of the Exhibition Commission an extra special prize, open to all nations, to consist of silver plate, for the best practical scheme for rendering the refuse from factories and sewage from towns, falling into the rivers and lakes, harmless to fish. Although the prize thus offered is intended for a complete solution of the question, partial solutions are not to be excluded from consideration by the jurors, who will also be instructed to decide as to the plan deemed second in order of merit. Such plan is to receive a prize of 600 marks from the Minister of Agriculture if possessing advantages over the systems now in use. Proposals from British subjects (which may be in print or manuscript, and accompanied or not by drawings) must be delivered prior to March 1st, 1880, at the London offices of the Exhibition, 1, Castle-street, Holborn. Apparatus and models intended to illustrate any of the plans so submitted may be forwarded subsequently to the Exhibition (which will be opened on April 20th); it will be necessary, however, to apply before January 1st for the necessary space for the same in the British Section.

NAVIGABILITY OF THE RIVER LOIRE.

A most important question as to Nantes in no distant future becoming a commercial seaport, is the navigable state of the River Loire between Nantes and St. Nazaire. Consul Clipperton states that, unless skilful and energetic works are shortly undertaken, the navigable channel will be silted up by the sand and refuse carried down from the upper river and its affluents. Official records show that so far back as the year 1625, the representatives of the city merchants appealed to the Government, and pointed out that vessels were obliged to anchor from four to five miles below the town, and discharge their cargoes into lighters. Various projects were made to deepen the bed of the river, or to cut a lateral canal, but all appear to have been laid aside almost as soon as contemplated, through want of funds or from opposition from different authorities. About the year 1775, an engineer named Mangin, strongly patronised by the Duke D'Aiguillon, obtained subsidies from the King and State to contract works, so as to concentrate the current into the two principal channels by means of dikes and drains to close up the minor channels. By this system, a greater depth of water was obtained in certain places, but fresh sand-banks and even large islands were formed further on; attempts on the same principle were made from time to time, to be followed always by the same results, namely, a slight increase in depth of water at the place of the works, but formations of fresh sand-banks and islands at some other point.

In 1851, the question was again energetically discussed; a committee of practical as well as of scientific men was formed, and it is strange to remark how obstinately the engineers of the Ponts et Chaussées adhered to the system which had already been tried and failed, while the practical men strongly recommended the cutting of a canal to St. Nazaire or some point near the mouth of the river. Probably owing to the great difference in the estimates of the cost of the two projects, the engineers again carried their point. By this means the real question was postponed. The work done by the engineers, instead of improving the channel of the river, caused greater impediments and danger to the navigation, as had been foretold by the practical men. Vessels bound down the river now required two, and even three tides, to carry them over the passes since formed. This state of things continued until the autumn of 1873, when M. Deseilligny, Minister of Public Works, visited Nantes. He then communicated, at a special meeting, that it had been decided by the Superior Council to reject the projects sent in. A deaf ear was turned by the high authorities to all reports and petitions relating to the Loire until the memorable round made by M. de Freycinet in the year 1877, furnished the opportunity to re-open the question and place it before the Minister as being the most vital one for Nantes. The Minister undertook to examine the matter most minutely, and, before starting for La Rochelle, let it be understood that the improvement of the navigation of the Loire would be one of the works in his general plan of ameliorations.

Eventually, a project, forwarded by Messrs. Rousseau and Joly, the chief and assistant engineers of the Ponts et Chaussées attached to the port of Nantes, in March, 1878, was accepted, and is now awaiting the sanction of the Chambers, which the Minister expects to be able to put in execution in the course of the year 1880. This project is to cut a canal on the left bank of the river between La Martinière and Le Carnet through Les Champneufs, and will be about 14 kilos. in length. The estimated cost of the works is 14,500,000 francs (£580,000). The depth of the water in the canal will vary between 5·90 metres and 6·35 metres. The report by Consul Clipperton is accompanied by a coloured drawing of the course of the Loire, the channel, and numerous sand-banks accumulated up to last year, and the territory through which the new canal is to pass.

CORRESPONDENCE.

TREES IN TOWNS.

Dr. Phené has left out of his list (p. 31) the fig, which grows in London as luxuriantly, and with leaves much brighter, than I have seen in the oriental fig districts. It is a very old tree in London, and though it has shiny leaves it resists the smoke, as it must always have done, for it was a garden tree in the City, where a few trees still remain.

Hyde Clarke.

APPRENTICESHIP: SCIENTIFIC AND UNSCIENTIFIC.

One salient fact, arising from the perusal of Professor Thompson's able and most interesting paper, is the recent date of the establishment in France of the apprenticeship-schools, which are described in it.

Some years ago it used to be said, and with much truth, that on the Continent technical education consisted almost entirely of theory, which, with us, was almost wholly neglected, and even sneered at in favour of practice. The establishment of such trade schools, as are named in the paper, both in France and in Germany, shows that their special deficiency has been realised, and active steps taken to remedy it, in so far as mechanical trades are concerned. With respect, however, to the higher professional education, in France at least, much remains to be done.

Take, for instance, the Ecole Polytechnique, at Paris, classed by Professor Thompson with St. Cyr, as a military school, which is hardly correct. For, while the latter is strictly a military school (its students being treated as privates or as non-commissioned officers in the army, who, at the successful termination of their course, are rewarded with an officer's commission), the Polytechnique course is the essential preliminary to all the higher scientific appointments under Government, whether civil or military. The military engineers (génie) and the artillery, the civil engineers (mines, ponts et chaussées, &c.), and other less important positions are the chief prizes held out to the successful students of the Polytechnique on leaving that institution. Three years there, with a similar term, in most cases, at the subsequently selected professional school, and spent almost entirely in theory (actual practice being all but ignored), converts the student into a full-fledged Government official, a personage extremely unlikely to unbend his dignity sufficiently to enable him to acquire the necessary practice, earned by manual labour, which should accompany so much theory. Exceptions, and very brilliant ones, there are, no doubt, to the one-sided result in most cases of all this careful and admirable education, but the opinion held by many French manufacturers and proprietors of industrial works, as to the value of this result, may probably be of interest, for, while they decline to have a Ponts et Chaussée man in their establishment, they readily give employment to an "Ancien Elève de l'Ecole Polytechnique," *i.e.*, to the man who has, through want of success in his final examination, been deterred (fortunately for himself) from devoting the second three years to theory in the professional school, and who has perforce turned to practise in some industrial works. The writer is himself quite disposed to coincide generally with this opinion, both from having been thrown, in Paris, during his education, with aspirants to the Ecole Polytechnique, and also from having in after life been much engaged professionally with members of the Ponts et Chaussées, and with others similarly educated.

The most urgent lesson for ourselves in this country, to be derived from Professor Thompson's paper, is that our two chief Continental competitors in the arts of

production, France and Germany, are now becoming fully alive to the importance of practice in technical education, and that theory alone will not suffice them. It, therefore, behoves us, hitherto the champions of practice, to remedy, and that quickly, the shortcomings as to theory which exist in our systems—else, we shall find ourselves, not merely inconvenienced, as we now are beginning to feel, but actually distanced in the competition of manufactures, and of other productive arts. James N. Shoolbred.

3, Westminster-chambers, December 6th, 1879.

NOTES ON BOOKS.

Tables of Metric Measures and their English Equivalents. By G. M. Borns. London: C. Gilbert. 1879.

This small volume consists of a collection of twenty tables calculated for use in the offices of engineers, architects, contractors, and others, where a reduction of the metric measures is frequently needed. They have only been calculated to such a degree of accuracy in the number of decimals as was considered necessary for practical purposes, but a special table of equivalents to five places of decimals has been added.

Ceylon Coffee Soils and Manures. A Report to the Ceylon Coffee Planters' Association. By John Hughes, F.C.S. London: Straker Brothers and Co. 1879.

The author made an extensive tour through the principal coffee districts of Ceylon, and afterwards completed at Colombo, a series of analyses of the various soils, and proposed manures, suitable for the coffee cultivation, the results of which are given in this report.

Our Railways. Should they be Private or National Property. By Edward J. Watherston. London: E. Stanford. 1879.

The object of the author of this pamphlet is to advocate the purchase of the railways of the United Kingdom by the State; and the advantages he believes would follow such action are (1) the lowering of fares and rates; (2), the suppression, as far as possible, of "accidents;" (3), the establishment of railway post-offices; and (4), the equalisation in value of landed property. The author proposes a plan of arranging railway fares by zones, and he believes that low fares would be as productive to the revenue as is the penny postage.

GENERAL NOTES.

Ancient Petroleum.—Professor Skeat has printed in the *Athenæum* a passage from North's translation of "Plutarch's Lives" (1631, p. 702), from which it appears that Petroleum was known in the time of Alexander the Great. The passage runs as follows:—"For a Macedonian called Proxenus, that had charge of the kings cariage [baggage], as he digged in a certaine place by the riuer of Oxus, to set vp the kings tent and his lodging, he found a certain fat and oily veine, which after they had drawn out the first, there came out also another clearer, which differed nothing, neither in smell, tast, or savour from natural oile, having the glosse and fatness so like, as there could be discerned no difference between them: the which was so much the more to be woudered at, because in all that country there were no oliues."

Wheat Harvest in South Australia.—The reports received by telegraph from Adelaide show that there has been an exceptionally fine wheat harvest in South Australia this season. The land under cultivation is 1,500,000 acres, and the average is expected to be twelve bushels of wheat per acre, a crop which would leave 375,000 tons available for exportation, the value of which is estimated at between £3,500,000 and £4,000,000. Heavy rains have fallen in the outlying pastoral country, and the dams are full.

Glycerine.—In the manufacture of glycerine France stands pre-eminent, as may be seen from the following figures, which show in round numbers, the relative production of the various countries:—

	Kilogrammes.
France	4,000,000
Germany and Austria	1,500,000
Holland	900,000
Russia	900,000
Belgium	800,000
Italy	400,000
England	300,000
Spain	100,000

Although glycerine was discovered by Scheele, in 1779, it is only within the last few years that it has been manufactured commercially.

Boxwood in Russia.—Boxwood grown in the forests on the shores of the Caspian Sea, is, says the *Gardener's Chronicle*, a large article of trade with Russia. This wood reaches Astrachan and Nizni-Novgorod in the spring of the year, were it is sold during the fair. Last year the quantity so sold was about 130,000 poods, being about 80,000 poods in excess of other years. It is pointed out in a recent report that the increased demand for this boxwood, which is used for shuttle-blocks, indicates increased prosperity among Russian manufacturers. On the subject of boxwood the acting British Consul at Tiflis writes:—"*Bona fide* Caucasian boxwood may be said to be commercially non-existent, almost every marketable tree having been exported. Such exorbitant terms are demanded by the Government for the right of cutting in one or two remaining Abkhasian boxwood forests as virtually to bar their acquisition." He goes on to say that having personally visited these forests he is in a position to assert that their real value has been considerably exaggerated, most of the trees being either hollow or knotted from age, and much of the best wood having been felled by the Abkhasians previous to Russian occupation. The boxwood at present exported from Rostov, and supposed to be Caucasian, comes from the Persian provinces of Mazanderan and Ghilan, on the Caspian. What has been said respecting boxwood applies equally to walnut burrs, or "loupes," for which the Caucasus was once famous, 90 per cent. of which now come from Persia. The walnut trees of the forests along the Black Sea, which are extraordinarily numerous, and afford excellent material for gunstocks, do not, from some climatic peculiarity, produce burrs, which are only found in the drier climates of Georgia, Daghistan, Persia, &c. The immense quantity of walnut timber in the forests on the Black Sea is mostly unavailable from the complete absence of roads or means of transport, and the dearness and scarcity of labour.

Case of Lightning-stroke.—A paper was read at a late meeting of the Clinical Society by Dr. G. Wilks, of Ashford, on a remarkable case of lightning-stroke, which occurred on June 8th, 1878. A farm labourer was struck by lightning while standing under a willow tree, close to the window of a shed in which his three fellow workmen had just taken shelter from a violent storm of rain. His companions found the tree partly denuded of its bark, and the patient's boots standing at its foot. The patient himself was lying on his back two yards off, and though he was fully clothed previously, he was now naked, with absolutely nothing on except part of the left arm of his flannel vest. He was conscious, but much burnt, and his leg was badly broken. The field around was strewn with fragments of the clothing; the clothes were split or torn from top to bottom, the edges of the fragments being often torn into shreds or fringes; they only showed evidences of fire where they came in contact with metal, such as his watch and the buckle of his waist-belt. There were no laces in the boots. The left boot was torn and twisted into fantastic shapes, but the sole was uninjured, and there was no signs of fire upon it; the right boot had the leather much torn and the sole rent and

burnt. The watch had a hole burnt through the case, and the chain was almost entirely destroyed. The stockings were split down the inner side; the hat was uninjured. The patient stated that he was struck violently on the chest and shoulders, became enveloped in a blinding light, and was hurled into the air, coming down on his back "all of a crash," and never losing consciousness. The hair of his face was burnt, and the body was covered with burns. Down each thigh and leg was a broad crimson indurated band of burning, passing along the inner side of the knee, and ending below the left inner ankle and at the right heel; a lacerated wound, with a comminuted fracture of the os calcis. The bones of the right leg were fractured, and the tibia protruded through the skin in the course of the burn. He was discharged healed twenty weeks after the occurrence. Dr. Wilks remarked on the almost complete exemption of the nervous system and on the probability that the clothes being wet acted as good conductors, and so diverted the electric current from the great nervous trunks, thus saving the man's life.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

The last meeting before Christmas will be held on Wednesday evening at eight o'clock:—

December 17.—"The Panama Canal." By Captain Bedford Pim, R.N., M.P.

At the meetings after Christmas the following papers, amongst others, will be read:—

"Domestic Poisons." By Henry Carr.

"Gas Furnaces and Kilns for Burning Pottery." By Herbert Guthrie, C.E.

"The Utilisation of Slag." By Charles Wood.

"Art in Japan." By C. Pfoundes.

"The Trade and Commerce of the Yenisei." By Henry Seebohm.

"Modern Autographic Printing Processes." By Thomas Bolas, F.C.S.

"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.

"Art Ironwork." By J. W. Singer.

"The History of Musical Pitch." By A. J. Ellis, F.R.S.

"The Recent History of Explosive Agents." By Prof. F. A. Abel, C.B., F.R.S.

"Iceland and its Resources." By C. G. W. Lock.

"The Future of Epping Forest." By William Paul, F.L.S.

Cantor Lectures.

Monday evenings, at Eight o'clock.

The First Course, on "The Chemistry of Bread and Bread-making," five lectures, by Dr. Charles Graham, F.C.S., F.I.C., Professor of Chemical Technology at University College, London.

Lecture IV.—December 15.

Fermentation. Leaven. Yeast. Ferments of disease. Changes produced. The use of the microscope in the examination of yeast.

Lecture V.—December 22.

Baking; changes produced by heat. Aërated breads; foreign breads; biscuits, &c. Digestion of bread a continuance of fermentation; conditions requisite. Conclusion.

The Second Course will be on the "Manufacture of India-rubber and Gutta-percha," by Mr. Thomas Bolas, F.C.S. It will consist of six lectures, to be given on the following dates:—Feb. 2, 9, 16, 23; March 1, 8.

The Third Course will be by Mr. R. W. Edis, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 15th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Charles Graham, "The Chemistry of Bread and Bread-making." (Lecture IV.)
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Odling, "A Recent Application of Organic Chemistry."
Law Amendment Society, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. F. H. Torr, "The Amalgamation of the Civil Courts of the City of London, and the Establishment of a Court of Arbitration to act as a Tribunal of Commerce."

Tuesday, Dec. 16th...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Continued Discussion, "The Passenger Steamers of the Thames, the Mersey, and the Clyde."
Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Mr. R. H. Patterson, "Is the Value of Money rising in England and throughout the World? With Remarks on the Effects of the Condition of Trade on the Value of Money."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Royal Colonial, "Pall-mall," 14, Regent-street, S.W., 8 p.m. Dr. Emil Holub, "The Past, Present, and Future Trade of the Cape Colonies with Central Africa."

Wednesday, Dec. 17th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Captain Bedford Pim, "The Panama Canal."
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Lieut. Herbert H. Russell, "A Sand Storm at Aden, July 16th, 1878." 2. Mr. George Dines, "A New Form of Hygrometer." 3. Mr. Richard Strachan, "Diurnal Range of Atmospheric Pressure." 4. Mr. G. M. Whipple, "Note on a Curious Fracture of a Solar Radiation Thermometer." 5. Mr R. H. Scott, "New Sunshine Recorder."
Geological, Burlington-house, W., 8 p.m. 1. Mr. G. C. Wallich, "Contributions to the Physical History of the Cretaceous Flints." 2. Mr. P. N. Bose, "Undescribed Fossil Carnivora from the Sivalik Hills, in the Collection of the British Museum." 3. Rev. J. F. Blake, "The Portland Rocks of England."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Society for the Development of the Science of Education, Memorial-hall, Farringdon-street, E.C., 7½ p.m. Dr. Gladstone, "Science in General."

Thursday, Dec. 18th...Royal, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. Rev. J. M. Crombie, "The Lichens of Dillenius, as illustrated by his Herbarium."
Chemical, Burlington-house, W., 8 p.m. Ballot for the Election of Fellows. 1. Mr. T. E. Thorpe, "The Specific Volume and Density of Water of Crystallisation. 2. Mr. W. H. Perkin, "The Analysis of Organic Bodies Containing Nitrogen, &c."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. W. A. Barrett, "Christmas and other Festival Carols." (Illustrated).
Royal Historical, 22, Albemarle-street, W., 8 p.m. 1. Rev. Arthur R. Pennington, "The Holy Roman Empire; or the Causes of the Disintegration of Germany." 2. Mr. Sydney Robjohns, "Some Account of the 'Jani Anglorum,' the 'Epinomis,' and other Works of John Selden." 3. Mr. Llewellyn Jewitt, "Historical Remarks on the Punishment of Women." (No. I.)
Numismatic, 4, St. Martin's-place, W.C., 7 p.m.
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Friday, Dec. 19th...Philological, University College, W.C., 8 p.m. 1. Mr. J. P. Postgate, "*Dare* to 'give,' and *-dere* to 'put,' in Latin." 2. Mr. Hy. Nichol, "English Etymologies, correcting some of Prof. Skeat's." (Part II.)
Bankers' Institute (in the Theatre of the London Institution, Finsbury-square, E.C.), 6 p.m. Mr. M. D. Chalmers, "The Difference between the English and Foreign Systems of Law regarding Bills and Notes, and their Relative Merits."

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FRIDAY, DECEMBER 19, 1879.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

PROTECTION OF SHIPS FROM LOSS BY FIRE AND FROM LOSS BY SINKING.

Intending competitors for the medals offered by the Society of Arts for the above objects, are reminded that models or drawings of structural arrangements and of appliances, must be sent in not later than the 1st of January, 1880, addressed to the Secretary, Society of Arts, John-street, Adelphi, London, W.C., and must in every case be accompanied by a short description.

Full particulars of the offer were printed in the *Journal* for September 5, and can also be obtained at the office of the Society.

The two objects to be dealt with are—

1. Protection of ships from sinking, after collision, after touching the ground, &c.
2. Protection of ships from fire.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. W. H. PREECE, on "Recent Wonders of Sound" and "Recent Wonders of Light." The dates for the lectures will be Friday, the 2nd, and Friday, the 9th of January next. The lectures will commence at seven o'clock. As the number of seats is limited, admission will be by ticket only. The issue of tickets is now discontinued, the full limit of the accommodation having been reached. The Secretary requests any member who is unable to use his ticket, to be so good as to return it, for the use of some one of those whose applications were too late.

NATIONAL CULTIVATION OF MUSIC.

The First Report on establishing Local Schools of Music, and Teaching Music by Notes in Public Elementary Schools, is now published, and may be obtained from the Society by transmitting one shilling in postage stamps to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FIFTH ORDINARY MEETING.

Wednesday, December 17th, 1879; General Sir GEORGE BALFOUR, K.C.B., M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, William Henry, 32, Vincent-square, S.W.
Christy, Thomas, F.L.S., 155, Fenchurch-street, E.C., and 64, Claverton-street, S.W.
Macnab, Henry Black, 1, Queen Victoria-street, E.C.
Mayne, Rear-Admiral, Richard C., 101, Queen's-gate, S.W.
Middleton, Reginald Empson, 5, Westminster-chambers, S.W.
Thuillier, Major-General Sir Henry Edward Landor, R.A., K.C.S.I., F.R.S., South Bank-lodge, Stratford-road, Kensington, W.
Ward, John H., Oakley-house, Caversham-hill, Reading.

The following candidates were balloted for and duly elected members of the Society:—

Ball, James, 3, Clarence-terrace, Avondale-road, Peckham, S.E.
Berry, Edward E., 27, Upper Bedford-place, W.C.
Bird, Alexander Frederick Samuel, Alderman, J.P., Mayor of Deal, 118, Beach-street, Deal, Kent.
Hunt, John Mortimer, 156, New Bond-street, W.
Le Cren, Henry John, 107, St. George's-square, S.W.
Neate, John, 53, Belsize-park, Hampstead, N.W.
Stewart, Robert, Mimosadale, Lordship-lane, East Dulwich, S.E.
Wilton, Francis, C.E., Lichfield-house, Lawrie-park, Sydenham, S.E.

And as Honorary Corresponding Member:—

Merino, Señor Don Ramon, General Post-office, Havana.

The paper read was:—

THE PANAMA CANAL.

By Captain Bedford Pim, R.N., M.P.

PART I.

Introduction.

Again we have the project of interoceanic communication between the Atlantic and Pacific brought before the world; this time in a manner which is calculated to arrest the attention and stimulate the energy of those interested, for has it not been introduced by one whose name is a household word in connection with the great work of his life, the Suez Canal? Need I say that I refer to M. le Comte Ferdinand de Lesseps.

The Paris Congress.

The mode adopted to give prominence to the desired enterprise, of opening the American Isthmus, was by calling a Congress at Paris to adopt the best route. Such a Congress was accordingly convened under the auspices of the French Geographical Society and M. de Lesseps, and held its sittings from the 15th till the 28th of May of this year (1879).

At first sight, this would seem to have been an admirable plan to call attention to the project,

and insure a practical result, but, unfortunately, Congresses, like Departmental Committees, are neither infallible nor even independent, and the selection of a route for the proposed canal seems to have been a foregone conclusion.

Panama Selected.

The line chosen was parallel, as near as possible, to that of the Panama railway, and was voted for by a great majority, as the following extract from the report of Admiral Ammen to the United States Government will show:—

"At 1.30 [on the 28th of May, 1879] the final full meeting of the Congress took place, the report, *résumé*, and resolution were read, and the yeas and nays taken upon the latter, resulting in a vote or abstention of 99 members out of 135, as given in the list—75 voting yes, 8 no, and 16 abstaining. The character of the voters and of those who absented themselves will appear in the report of Civil Engineer Menocal. I abstained from voting on the ground that only able engineers can form an opinion after careful study of what is actually possible, and what is relatively economical, in the construction of a ship canal.

"The text of the resolution is as follows:—

'Le Congrès estime que le percement d'un canal interoceanique à niveau constant, si désirable dans l'interêt du commerce et de la navigation, est possible, et que le canal maritime, pour répondre aux facilités indispensables, d'acces et d'utilisation que doit offrir avant tout un passage de ce genre, devrà être dirigé du Golfe de Limon à la baie de Panama.'

"The hall was densely crowded, many ladies being present; about one hundred members or delegates, and three to four hundred other persons. Whenever a vote of 'yes' was given, especially by some one who had more or less opposed the conclusion, a very enthusiastic clapping of hands occurred, which would hardly have been the case had the audience regarded the selection as depending wholly on natural conditions or advantages, or on physical causes. The Congress then adjourned."

M. de Lesseps.

It is impossible to disguise from oneself that the strong and very natural personal feeling of the members of the Congress towards M. de Lesseps was allowed to override a strict practical dealing with the subject, which alone could command the respect and adhesion of the public.

Strangely enough those most deeply concerned seem either to have taken but little interest in the proceedings, or to have been left out in the calculation vulgarly called "counting noses." Be that as it may, the practical result of the Congress amounts to this, that a "Panama Canal" was voted, and its execution entrusted to M. de Lesseps. The United States, through their official delegate, Admiral Ammen, did not approve of such a decision, preferring, for very substantial reasons, the route by way of the River San Juan and the lakes of Nicaragua.

American, English, and French Interests.

In discussing the subject of interoceanic communication between the Atlantic and the Pacific Oceans, it is very necessary to ask ourselves the question, "Who are those interested?"

Now, I have given this matter very serious consideration, and I have come to the conclusion that, while it is true that every nation under the sun may claim to have an interest in the international work of piercing the isthmus of the New World, if only from a sentimental point of view, yet, practically, the success of the undertaking depends upon three parties.

Of these parties, first and foremost stand, of course, the American States. I do not mean the United States, but all the States of America. Secondly, England; and thirdly, France, though in a minor degree, and simply because she has possessions in the West Indies, and has long been desirous of extending her commerce across the isthmus into the Pacific.

These three nations, then, are "those interested," upon whom will devolve the risk and expense of an undertaking, which it cannot be denied, must be one of very considerable proportions.

How Represented at Congress.

Let us see how these interests were represented at the Paris Congress; and, first, as regards France, I think it may fairly be said that it would have been impossible to find a better representative than M. de Lesseps. I will even go a step further, and say that it would have been more satisfactory if M. de Lesseps, in the first instance, had embodied the Congress in his own proper person, and exercised his great practical intelligence without seeking the uncertain and heterogeneous assistance of a Congress at all.

England was not officially represented, although it is quite true that Colonel Stokes was announced as our delegate. Upon writing, however, to the Foreign-office on the subject, I received the following reply, which settles the matter, and correctly measures the interest taken by our Government.

Letter from Foreign-office to Captain Pim.

Foreign-office, May 8th, 1879.

Sir,—Lord Salisbury has desired me to acknowledge the receipt of your letter of the 3rd inst., inquiring whether it is true that three delegates have been appointed by her Majesty's Government to attend the Conference at Paris on Interoceanic Transit across Central America.

In reply, I am to inform you that no delegate has been officially named to represent this country, but that Sir John Stokes has been invited by M. de Lesseps to attend the Conference, and he has received the permission of the Government to accept the invitation.—I am, sir, your obedient servant,

(Signed) Philip Currie.

Captain Bedford Pim, M.P.

In respect to the United States, not only was a representative appointed in the person of a distinguished officer of the Navy, Rear-Admiral Daniel Ammen, assisted by Anecito G. Menocal, Esq., Civil Engineer of the United States Navy, but particular instructions were given to the Admiral for his guidance in the important mission with which his Government had entrusted him.

The following is a copy of the instructions given to Admiral Ammen; they are of value in this connection as showing the very natural interest taken by the Government of the United States in any project for piercing the isthmus of their country:—

Admiral Ammen's Instructions.

Mr. Evarts to Admiral Ammen.

Department of State,
Washington, April 19th, 1879.

Rear-Admiral Daniel Ammen, U.S.N.,
Washington, D.C.

Sir,—The President having appointed you to be a Commissioner on behalf of the United States, to attend

an International Conference to assemble at Paris, on the 5th May proximo, under the auspices of the Geographical Society of Paris, for the purpose of considering the various prospects of an international canal across the American Isthmus, I have the honour to acquaint you officially with the fact of such appointment. It is also incumbent upon me to give you certain instructions for your guidance, in the execution of the President's wishes. The importance and magnitude of the projected enterprise are such as to command earnest attention, especially on the part of those countries whose trade is to be affected in a marked degree by the success or failure of the scheme.

This Government, in the interest of its rapidly growing commerce, not only between its own Atlantic and Pacific shores, but with the other American States on the western coast of the Continent deems it advisable to keep itself well informed on the subjects, and also to give any useful information in relation thereto to other Governments interested in the scheme of interoceanic communication.

You are accordingly instructed to attend the Conference of the International Commission concerning the opening of an interoceanic canal through the American Isthmus, to be held at Paris next month, and you will be expected to carefully watch its progress and results, and report them to your Government.

You will take part in the discussions of the Conference, and will communicate such scientific, geographical, mathematical, or other information as you may possess, and as is desired or deemed important. In this work you will be assisted by Civil Engineer Anecito G. Menocal, of the United States Navy, who has been detailed and appointed a Commissioner for the purpose with like powers. You will, however, have no official powers or diplomatic functions.

You will hold no official communication with the officers of the French Government, except such as may, by virtue of their connexion with the French Geographical Society, or as delegates, *ad hoc*, take part in the proceedings of the Conference. You are not authorised to state what will be the decision of the Government of the United States in regard to the points involved or the line of action it will pursue.

The Conference is understood to be, not one of diplomatic representations of the respective Governments, but rather a gathering of scientific men and public officers, whose experiences render it desirable that they should have an opportunity for the exchange of information and of views. Your well-known wide acquaintance with the subject proposed to be discussed makes it peculiarly fitting that you should be selected to meet other distinguished engineers and officers who have given like attention to the matter.

You are furnished herewith with such documents and records as the files of this and other departments contain, that may be of interest and importance.

Your own familiarity with the subject, and careful study of it in all its bearings, render it unnecessary to give you further instructions on this point.

I am, Sir,

Your obedient servant,

William M. Evarts.

These instructions sufficiently attest the interest attached by the United States to the canalisation of the American Isthmus, which is also manifest by the light of subsequent events; still no attempt whatever has been made to embarrass in the slightest degree the movements of M. de Lesseps, although means have been taken to make it known that the route which will be favoured by the United States is not that selected at the Paris Congress; on the contrary, the scheme of M. de Lesseps will be avoided altogether, and the canal built, if anywhere, through Nicaragua, although the exact direction will not be decided upon without further surveys and lines of new levels.

Upon this point, and to show the steps already taken by our energetic cousins across the Atlantic, I beg to call your attention to an extract from the *Times* of the 4th October last.

The following is General Grant's letter to Admiral Ammen, in which he consents to the latter's request to take the presidency of the proposed Nicaragua Canal Company:—

"Tokio, Japan, August 19th.

"My dear Admiral,—Your letter of the 2nd of July reached me a few days since. After two days' reflection of the part I should take or consent to take—if offered—in the matter of the interoceanic canal, *viâ* Nicaragua, I telegraphed to the Secretary of the Navy at Washington:—'Tell Ammen I approve.—Grant.' I hope you received the despatch. On the 27th, two weeks after this leaves Yokohama, we sail for San Francisco. I do not feel half so anxious to get home as I did 18 months ago. There is no country which I have visited, however, this side of Europe, except Japan, where I would care to stay longer than to see the points of greatest interest. But Japan is a most interesting country, and the people are quite as much so. The changes that have taken place here are more like a dream than a reality. They have a public school system extending over the whole empire and affording facilities for a common school education to every child male and female. They have a military and a navae academy which compare well with ours in the course taught, the discipline, and the attainments of the students. They have colleges at several places in the empire on the same basis of instruction as our best institutions. They have a school of science which I do not believe can be surpassed in any country. Already the great majority of their professors—even those engaged in teaching European languages—are natives, most of them educated in the very institutions where they are now teaching.

"But I hope to meet you soon, and then I will say more on this subject than I care to write in the limit of a letter.

"Mrs. Grant sends her love to Mrs. Ammen and the children. Please remember me kindly also.

"Yours truly, "U. S. Grant.

"Admiral D. Ammen."

Résumé.

This, then, is the position of affairs. Through the influence of M. de Lesseps, a Congress was convened, and met at Paris in May last. It consisted of 135 members, and the result of its action was a vote of confidence in M. de Lesseps, and his favourite plan, as embodied in the following resolution, was carried by ayes, 75. Noes, 8; not voting, 16; absent, 36.

"The Congress considers that the cutting of an Inter-Oceanic Canal at the sea-level, so desirable in the interests of commerce and navigation, is possible, and that a maritime canal, to afford those indispensable facilities of access and utility which such a passage must, above all things, possess, should be carried from the Gulf of Limon to the Bay of Panama."

A Canal, *à niveau constant*, at the sea level, and without locks, is no doubt the most desirable mode of joining together two oceans. No process can be more simple, if only the intervening land is level and below the level, as at Suez (M. de Lesseps' model work), and there is besides every advantage in the shape of climate, abundance of labour, and the ease with which labour-saving appliances can be used; but it is a very different affair when the

reverse is the case, and, moreover, the harbour accommodation at either end is, to use a mild term, indifferent. From these causes alone the work of opening a canal between the Atlantic and Pacific across the Isthmus of Darien or Panama assumes gigantic proportions, and bears about the same proportion to that at Suez as the excavation of Mount Cenis to the boring of a tunnel under the Thames to-day. It is not, therefore, to be wondered at that adverse criticisms were levelled at M. de Lesseps' scheme, even before the breath was out of the body of the Congress; and, that the subsequent growth of such criticisms has had the effect of staying his proceedings, so that at present the scheme of cutting a canal, *à niveau constant*, on a line parallel to that of the Panama Railway, is in abeyance.

Indeed, the project is not likely to be revived, for independently of the difficulties I have mentioned, the locality is not adapted for the purpose in view, owing to the persistent calms which effectually bar the approaches to sailing ships, and vex the navigation beyond endurance.

I have had long experience of the physical geography of Central America, and the Bay of Panama in particular. On one occasion, the frigate *Herald*, in which I was serving, was towed by H.M.S. *Sampson* 700 miles off the land before picking up the slightest breeze; but although my practical experience on both sides of the isthmus happens to be very extensive, I will not on this occasion rely upon it, but call your attention to a letter bearing on the subject, addressed to me from my old friend, the late Commodore M. F. Maury, LL.D., familiarly known to us—I may truly say to all the world—as the author of that charming work, "The Physical Geography of the Sea." His name is a household word as the greatest authority on this subject, not only among his own countrymen in the United States, but quite as much with us Englishmen. His letter is dated as far back as July, 1866, and I am sure the members of the Society of Arts will have much pleasure in seeing it published in full in their *Journal*, as a most important contribution to our scientific knowledge of the Isthmus of the New World.

Commodore Maury tells us in the plainest language that "If nature, by one of her convulsions, should rend the Continent of America in twain, and make a channel across the Isthmus of Panama or Darien, as deep and as wide and as free as the Straits of Dover, it would never become a commercial thoroughfare for sailing vessels." I have only to endorse this opinion, for, of all parts of the world I have ever visited, the calms which prevail in the Bay of Panama are the most vexatious and enduring.

It is, therefore, by no means surprising that M. de Lesseps is taking time to reconsider his position, and, from what I know of that gentleman's character, I hope and believe that such consideration will be so shaped that his genius, his experience, and his wonderful energy and perseverance will, under no circumstances, be lost to those who seek the junction of the Atlantic and Pacific, no matter by what route, or whether at the sea level, or with or without locks.

The following is the late Commodore Maury's letter on the physical geography of Panama and Nicaragua:—

My dear Captain Pim,—I had occasion some years ago to study, more or less closely, almost every route between the British possessions on the north and the Isthmus of Darien on the south, whether for rail or canal, that had up to that time been attempted or projected across the American Continent.

Owing to the character of the researches with which I have been for more than twenty years engaged, my attention was directed to those routes rather in their physical and commercial aspects, than to their topographical features, or to their facilities of construction.

The great importance of one or more good commercial highways across Central America being admitted, the whole question as to route resolves itself pretty much into a question of the cost of construction, and the facilities of ingress and egress by sea, to and from the opposite termini; the latter is an affair of winds and currents. Their influence is powerful. Panama has the advantage in shortness of land transit; Nicaragua has the advantage in winds, terminal ports, and climate. The first is obvious; but to place the latter in a clear light, a little explanation may be necessary.

To make this explanation clear, let us, with Panama as a centre, take a general survey of the winds as they prevail in the Pacific Ocean.

As a rule, the prevailing winds in all that belt of ocean extending from the parallel of 35° north down to the parallel of 35° south, are from the eastward. This belt is 70° of latitude broad; in it are included the bands of the north-east and south-east trade winds, and the belt of equatorial calms; the latter separates the two systems of trades, and extends all the way across the Pacific.

Looking westward, therefore, from Panama towards the Islands of the Pacific, or towards Australia, China, or Japan, you observe that Panama is directly to windward of them all—and that, therefore, whilst the commercial routes from Panama to any of these places are all down hill, or to leeward, the way back is up hill, to windward (for over this broad band of the ocean easterly winds blow all the year, except now and then, when they are interrupted for a short time by the monsoons). Still, by making a detour, the return voyage to Panama would not be so difficult as from this statement it would appear to be, were it not for other physical conditions which stand in the way of navigation.

I have spoken of a calm belt about the Equator; Panama is within its range. Owing to the contour of the central American Isthmus, the height and direction of the mountain ranges by which it is traversed, and the influence of these upon winds, this calm belt is greatly enlarged on the Pacific or lee side of the Isthmus.

It is difficult to convey to one who has never experienced these calms, an idea of the obstinacy with which they vex navigation. We are all familiar with calms at sea, which last for a few hours, or even a day, but here they last for days and weeks at a time. I have known vessels going to or from Panama to be detained by them for months at a time. An American sloop-of-war, bound from Mezatlan, in Mexico, to Callao, in Peru, once attempted to make a short cut by running down the coast. She finally succeeded in passing these Panama calms, but she was delayed and baffled by them and the adverse currents from the south, until her provisions fell short, and she had to put into Payta to avoid starvation. The Humboldt current, which skirts the coast of South America all the way from Cape Horn, is felt in the offings of Panama.

The Gallapagos Islands, a fine and fertile group, are within the influence both of this current and of these calms; they are about 600 miles from Panama and about 500 from the South American coast; they tell, in their mute way, a curious story about these calms. Though so near the Continent of America, they are the only islands in that wide ocean capable of sustaining a population, that were uninhabited when discovered.

The reason is to be found in these calms; and simply because the wind there never blows continuously enough to waft a canoe from any quarter upon their shores.

On one occasion the British Admiralty, wishing to send one of their sailing vessels into the Arctic Ocean from Panama in time to save the season, had her towed by a steamer through the calm belt, and carried 700 miles out to sea before she could find a breeze.*

Panama is not in the centre of this calm belt; it is to the north of the centre; and consequently a sailing vessel, by shaping her course directly south from Panama, would, though bound for Peru or Chili, not only have to encounter the force of the Humboldt current, feeble though it be, but she would get into the thick of these "doldrums;" she must, therefore, to avoid them, be content to run along to the westward for upwards of 200 miles until she approaches the coast of Costa Rica. Here the coast-line trends off to the northward and westward; she follows it, reaching the latitude of Realejo before she can get fairly within the north-east trade winds, upon which she depends for gaining an offing and getting fairly out to sea. Having come up to them, she stands off to the southward and westward with flowing sheets, taking care not to cross the belt of equatorial calms within a thousand miles of Panama, nor until she can reach it in a much narrower part. Her port now lies to the southward and eastward, but she has entered the south-east trades, which are directly ahead. Consequently, she has to stand off on a bow line to the southward and westward, until she can clear these winds and get others from the west; this takes her as far south as 35°, and often beyond 40°. Here she makes her easting, taking care to bring her port so to bear, that she can fetch it with the south-east trades again. Such is the way often taken, under canvas, from Panama to Valparaiso, "the Chinchas," Callao, and all the "Intermedios." This is a curious route, but one that is not unfrequently pursued by the cleverest navigators; it would be well, for the better understanding of these facts, to refer to the map, for in consequence of these calms (and there are no others in the world like them) you will observe that this route actually takes the ship farther beyond, or to the south of "the Chinchas,"—if they be her destination,—than she was to the north of them when she got under way from Panama.

Upon the rush which took place for California, in consequence of the discovery of gold there, the route at first pursued by the sailing vessels, which doubled Cape Horn, both from Europe and America, was to cross the equator in the Pacific, in about longitude 90 degrees west; this brought them along the outer edge of the Panama region of baffling winds, and made their average voyage out, one of six months. Cases occurred on this route, in which the passengers, to avoid starvation, actually abandoned their vessel in these calms, took to their boats, and so reached land.

This continued to be the route until the investigations of the winds and currents in the Pacific (to the results of which investigations I am still speaking) enabled me to point out a better one. Captains were then advised to avoid those Panama calms, and instead of crossing the Equator in the Pacific, near the meridian of 90° west, they were recommended to cross it some 25° or 33° more to the westward. They did so, and this is the favourite route under canvas now; and the passage by it, instead of requiring six months, averages four.

These remarks apply to the approach and departure by sea to or from the Pacific terminus of any route across the Isthmus of Panama or Darien, and even with greater force to the Atrato and others on the South American side of Panama. In short, the results of my investigations into the winds and currents of the sea, and their influence upon the routes of commerce, authorise the opinion which I have expressed before, and which I here repeat, namely,—if Nature, by one of her convulsions, should rend the Continent of America, in twain, and make a channel across the Isthmus of Panama or Darien as deep, and as wide, and as free, as the Straits of Dover, it would never become a commercial thoroughfare for sailing vessels, saving the outward bound and those that could reach it with leading winds. Steamers would, and coasters might use it, but homeward bound vessels in the China, India, or Australian trade, rarely.

Such, so far as the winds are concerned, are the physical difficulties in the way of a great commercial highway at the southern extremity of Central America, and which no engineering skill, however great, can overcome. I shall have occasion to refer again to the Panama route for other contrasts.

In the meanwhile, let us turn to the most northern of these Central American routes, for which subventions have been obtained.

After, and in consequence of, the discovery of gold in California, the subject of a shorter and better route than that in use—viz. the "180 days' passage," *viâ* Cape Horn, was discussed in commercial circles. A "gateway" to the Pacific now for the first time engaged the earnest attention both of the people and Government of the United States. The route next in favour after that of Panama, especially in New Orleans, was that called the Tehuantepec route, having its Pacific terminus in the gulf of that name, and its Atlantic terminus at the mouth of the Coatzacoalcos river. It had attracted the attention of Cortez,—the world was familiar with the idea of a grand commercial thoroughfare there. A grant with munificent franchises had already been obtained from Mexico, and a company was speedily organised with ample means, first to construct a plank-road between the head of the navigable streams on the two sides, and then a ship canal.

This route was much more attractive than the Panama route to the people inhabiting the Mississippi Valley; Panama is nearly equi-distant from New York and New Orleans, but the Tehuantepec route would be a saving to the States bordering on the Gulf of Mexico, of no small moment both in time and distance, for its eastern terminus is almost at their door. With a strong bias in its favour, I was invited to discuss its merits. I was forced nevertheless to condemn it, and to decide, as between the two, in favour of Panama, at that time its rival in the money market and for the public patronage.

The Tehuantepec route was condemned as impracticable for two principal reasons: no engineer could be found rash enough to undertake, for any practicable sum, to build a safe harbour for its terminus on the Pacific, and deepen the water on the bar at the mouth of the Coatzacoalcos. Moreover, the violence of the "northers," for which the Gulf of Mexico is celebrated, would make the anchorage off its eastern terminus for ever unsafe at certain seasons. This route, therefore, was abandoned, although the climate, the resources on the wayside, and the distance, were all greatly in its favour. It lacked harbours.

No other route to the north of the peninsula of Yucatan has been brought to my attention.

Passing it, we leave the Gulf, and enter the waters of the Caribbean Sea, from which various routes have been projected, and several of which have been pressed with more or less zeal upon the public; none of these, however, save the several Nicaraguan routes, seem to have had merits enough to arrest the attention of capitalists, or to deserve serious consideration, except perhaps the Honduras route. Little or nothing is known about the topographical features of that route; I rather fancy a careful survey there would disclose heavy gradients and sharp curves. But, be that as it may, that route, as drawn by the pen on the chart, looks very attractive, both on account of its shortness and the harbour facilities afforded for each terminus. Its terminus on the Pacific is close to that selected for the Nicaraguan

* H.M.S. *Herald*, in which ship Captain Pim was then serving.

road, and is quite as commodious. But admitting the gradients to be ever so easy, and the curves few and gentle, the winds interpose an obstacle that is fatal to this route as the highway of commerce between the two oceans.

Look at the chart; you observe that the eastern terminus of this route is in the corner of the coast, forming a right angle and opening out to the north-east. The north-east trade-winds blow home here, and consequently a vessel wishing to clear from this end of the route, no matter for what port, would find herself embayed at the very outset, and under the necessity of a "dead-beat" of 400 or 500 miles, against the whole force of a head sea and the north-east trades, before she could be said to have gained an offing. This would make the passage from this end of the Honduras route to England, but little, if any, short of the homeward passage round the Cape of Good Hope, from India and China, or around Cape Horn from Australia. With this fact staring you in the face, nothing more need be said of the Honduras route until canvas is driven from the ocean by some cheaper and faster means of propulsion.

We come now to the Nicaraguan routes. Of these there are several. Though longer across from ocean to ocean than Panama, some of them have already, and with a degree of success by no means discouraging, competed with it before the world for public favour.

The Emperor of the French himself proposed and advocated the establishment of a great commercial highway across this part of the Continent. Later, M. Belly, adopting his idea, obtained a grant, and proposed to construct a Nicaraguan ship canal across from sea to lake and from lake to ocean.

At first this project found favour with the Emperor. He was disposed to take it under Imperial patronage. But he was not content with a topographical survey of the route. There were other physical conditions and circumstances which that sagacious monarch knew might exercise a controlling influence over such a work. He, therefore, chose to refer it for examination by the lights which the investigations concerning the winds and currents of the sea might cast upon it, and I was also invited to give my opinion upon it, according to any other information I chanced to possess. For this purpose, M. Belly's data and arguments were all placed before me; but suffice it to say, that when the matter came to be treated in connection with the existing requirements of commerce, this canal scheme proved to be wholly impracticable at the present day, and it was consequently given up.

Another Nicaraguan transit route was started by Vanderbilt and others, of New York, in opposition to the Panama road. They "established a line across," and "put on a line of steamers" to run in connection with it between New York and California. The passengers were conveyed across partly by lake and river steamboats, partly by stage-coaches, and on mules; and yet, although they occupied two days in the transit, this route, even with such drawbacks as these, fairly divided with Panama the passenger traffic. It was finally bought off by the Panama Company.

In 1849, this transit company, under the title of "The American Atlantic and Pacific Ship Canal Company," obtained a grant from Nicaragua, and entered into a contract with that State, for the construction of such a work. Eight years after, however, I find them soliciting a modification of this contract, on the ground that there was not water enough in the lakes of Nicaragua to float such ships as the canal was intended to pass. Thus the ship canal question appears to have been disposed of for the second time, and perhaps until the Pacific slopes of Mexico, California, Oregon, and Columbia shall be further subdued, and be more abundantly replenished with inhabitants.

It is through this country and near the canal route that the railroad proposed by you is to run. I have never been on the Isthmus and know nothing of the engineering difficulties of the road, nor of the typographical features of the country, but have reason to believe that they are by no means difficult. Skilful engineers, both French and American, have examined them. Those of both nations report gradients enough for a canal. We may safely infer therefore, that the route for your road presents no difficulties that the railway engineer need fear. Indeed, I am assured that the curves are gentle and the gradients easy. In truth, the lakes, their distance from the sea and their height above it, indicate that the summit-level is to be attained without any very steep ascents.

It is to this part of the Isthmus too, to which we must look for a route which shall best fulfil the present requirements of commerce between the two oceans, as well as of transportation and travel between the Pacific shores of North America, on the one hand, and the Atlantic shores, both of Europe and America, on the other. The ship canals have all been virtually abandoned, at least for the present, by their original projectors, and the road now proposed is required to supplement the Panama route. The South American markets are now giving the Panama route as much as it can do. English merchants have, within the last few years, put on a line of steam propellers between Panama and the coast south as far as Chili. These have given the road an enormous increase of traffic; no such increase has come from the North American side. Your road would draw it from that quarter, and vessels under canvas would, in the main, do the fetching and carrying for the Nicaragua route, which, for reasons already stated, cannot be done for Panama. The aggregate amount of this trade is immense, and it is neither accommodated for Panama, nor Panama for it. For this reason, as I have said, one route will supplement the other. One has already its chief traffic with the south coast, the other will have it with the north, the islands of the Pacific, and its western shores.

Nicaragua will also receive by canvas, from the ports of Chili and the South, an immense amount of commerce that cannot afford to go to Panama by steam, and that never will reach it by canvas.

Moreover, though the distance, as the crow flies, from Nicaragua to Chili and Peru, is greater from Nicaragua than it is from Panama, yet the average sailing voyage is much less in time.

Your road, therefore, as a thoroughfare for trade and travel with certain marts in the Pacific, may, in particular aspects, boast of important physical advantages which are wanting to Panama. Do they constitute inducements sufficient to tempt capitalists to embark in it as an investment?

This, I take it, is the real point to which you wish me to come.

The value of the franchises conceded under the grants to each route are better understood by you than by me, for I have not carefully studied either of them; and as for the relative character of the difficulties or facilities which stand in the way of the engineer or beckon him on, you require no opinion from me, even if I felt myself qualified to express one, which I do not.

Therefore, returning again to the physical features of the Panama route, as I promised to do, we can now compare more in detail than I have yet done, the advantages possessed by each, as far as those advantages are influenced by facilities of navigation, by the elements, by salubrity of climate, and by the dictates of commerce.

The French and English Admiralty charts give the most accurate information that I possess concerning the harbours at the opposite ends of the two routes, Panama and Nicaragua—I mean, as to mere anchoring ground, depth of water, and shelter afforded.

It is proper to remark here, that I was a great friend, an earnest advocate, and active supporter of the

Panama road, giving it in 1849 the preference over all other isthmian routes. At that time my "wind and current" investigations had not extended into the Pacific Ocean; and the discovery of those causes which make the approach and departure to and from the Bay of Panama so very difficult for sailing vessels, had not been sufficiently established to give them their proper weight.

That I may make myself clear as to the obstacles which these researches, confirmed by the experience of the Panama Company themselves, have shown to be in the way of the Panama route, I send you a chart, on which I have roughly sketched the trade-wind regions of the Pacific, the parts of the ocean where the Panama calms dominate—the deeper the shading the more vexatious the calms—and the route of vessels, trading under canvas, between Panama and the various ports in the Pacific. You will observe at a glance that the Isthmus of Panama, or Darien, is, on account of these winds and calms, in a purely commercial point of view, the "most out-of-the-way" place of any part of the Pacific coast of intertropical America.

You will observe also that the offings of Realejo are not beset with calms at all comparable for obstinacy to those which hinder navigation in the bay and offings of Panama. The reason of this is, that Realejo, instead of lying within the range of the Darien calms, lies in the regions of the "little monsoons" of Central America (N.E. trades), which, in August and September, blow from the south-west along this part of the coast. They are "soldiers'" winds for coasters in either direction, and do not extend far to seaward.

In consequence of this difference in the character of the offings of the two routes, the Pacific terminus of the Nicaraguan transit is on the wayside of the sailing voyage from Panama even to Callao and Valparaiso. You observe that the region liable to these Darien calms, extends from a little to the westward of Panama Bay, and thence along the Pacific coast, all the way to the Equator. It does not cross the continent, but, like a wedge with the blunt edge resting on the land, it extends far away to the west, getting narrower and narrower as it goes, and consequently more easy to cross from north to south, but more difficult to traverse from point to base or from west to east.

With this explanation, it is easy to understand how it is that sailing vessels from Panama often have to go north to get south. That also is the best way to get out to sea when bound in any other direction. Panama is in 90° N.; the distance thence to the Equator is between five and six hundred miles. Navigators look on "this passage to the Line as the most perplexing experienced in the Pacific for sailing vessels; thirty days is not considered out of the way, owing to calms, squalls, and torrents of rain which fall during these months,"* *i.e.*, in the rainy season.

H.B.M. ship *Monarch* had to be towed across the line by a screw steamer after leaving Panama and taking this route.†

"Lieutenant Maury," remarks Mr. Hull, Master of H.M.S. *Havanah*, truly says that the passage under canvas from Panama to California is one of the most tedious, uncertain, and vexatious that is known to navigators."‡

Realejo is on the northern verge of these calms, and where they have nearly ceased to be vexatious to the navigator at any season. Here then is the physical advantage in favour of the Nicaraguan route, for which it is difficult to find the money value.

Having obtained an offing from the Pacific terminus of either the Panama or Nicaraguan route, the winds are fair for all voyages, except those on the ports of South America.

But on the return voyage, the Nicaraguan Transit Terminus is again on the wayside from the islands of the Pacific, from California, British Columbia, the mouth of the Amoor, Japan, China, &c. The returning ship has to fetch a compass to the north; this brings her into the westerly winds, which prevail north of the fortieth parallel of north latitude, and lead her along the north-west coast of America. Consequently, in running it down, all such trades have to pass the shores of Nicaragua to get to Panama.

Then in coming from Australia there is a choice of routes: the sailing vessel may either run down to the south of 45° south latitude to make her easting in the westerly winds of that hemisphere, and then steer north; or she may steer north on leaving Australia, cross both systems of trades, and make her easting on the polar side of 40° north. This last route is the one recommended by the sailing directions.

As regards the line of steamers in contemplation between Panama and Australia, they can go straight enough, and have the wind quartering all the way; but returning by the same route, they will have a stiff and strong breeze "right in their teeth;" and as the south-east trades are stronger than the north-east, it is probable that even the steamers, upon trial, will find it more convenient to go north about and pass the offings of Realejo on their return voyage to Panama.

But the great centres of trade to which a good commercial highway across Central America would lead and develop, lie principally in the northern and not in the southern hemisphere; and here the Nicaraguan road has greatly the advantage over Panama, by shortening the actual distance.

By the great circle, and consequently the best route for steamers between Realejo, China, Japan, &c., British Columbia is on the wayside, and by touching at Vancouver—as it is about halfway—the voyage between Realejo and Japan or China would be divided into two parts, each about equal to a voyage by steamer between Liverpool and Norfolk in Virginia.

Both of the Isthmus routes have their rainy season: that of Panama is long and trying. In Nicaragua the season is not so long, and there the rains generally come on in the afternoon, after which it clears up till the next p.m. On the Isthmus of Panama the atmosphere is reeking with moisture, and the rain pours all the time. That calm place is one of nature's condensers. The air there is, during the rainy season, as damp as vapour can make it.

There are certain classes of goods liable to damage in such a damp and warm climate, even during the mere transit, and a larger class that stowage there would ruin. These objections apply also to Nicaragua, but not by any means with equal force, or to such an extent, for this simple reason—its rainy season is not so long or so severe, its climate is not so damp, and its dew-point by no means as high. Many classes of goods, if shipped under canvas from Panama in the rainy season, would be damaged ere the vessel could clear the calm; not so from Nicaragua.

Of all the climates of America, the climate through which the Panama road runs is the most pestilential. Few places in the world are so sickly as to give their names to disease. We hear of the Asiatic cholera and the coast fever of Africa; but the termini of the Panama road are the only places in America that have won this unenviable distinction. The Chagres fever on one side, and the Panama on the other, are known throughout the coasts of that continent, and dreaded by all who visit there.

The "Transit Route of Nicaragua" is exempt from these heavy drawbacks of dampness and disease. It passes through a salubrious climate. The soil is productive, its pastures abound in cattle. I never heard of any disease peculiar to the country, nor of especial virulence there.

Both its soil and climate are adapted to the cultiva-

* "Maury's Sailing Directions," 8th edition, 1859, p. 777.
† Ibid.
‡ Ibid., p. 778.

tion of coffee, sugar, rice, tobacco, cocoa, indigo, and the like, while in its forests you may gather drugs and spices, with ornamental and dye woods of rare beauty and excellence. These, this route will in the process of time bring into the channels of commerce, and convert into valuable sources of revenue. The Panama Railroad has developed no feeders, and its wayside business, in a commercial light, is simply *nil*. It would be very different in Nicaragua.

The Pacific termini of the two routes thus present marked contracts; but with the exception of the "northers," those in the Caribbean Sea offer none worth considering as regards the winds and currents. The harbour accommodations of the Nicaraguan transit appear to be superior to those of Aspinwall; moreover, the former is completely sheltered from the violent winds of that coast, while Aspinwall is open to all their fury, although even the harbour of Aspinwall appears to have answered its purpose.

To conclude, you see the sum of all these disadvantages of the Panama route, expressed by the road itself. It has been opened about twelve years; but sailing vessels go and come by the old routes, as though it were not, and they double Cape Horn in greater numbers than ever. Few are the cargoes of merchandise to or from the east, that have found their way across that road. And though its earnings are enormous, it has, as a commercial highway, disappointed the world and the expectations of its advocates from the time of Columbus down; he thought the "gates of ocean" were there, and his day dreams, as he lay ill with the fevers for which Chagres and Panama have won notoriety, were to "unbar" them. It has not altered a single old route of commerce, but it makes enormous dividends for all that.

That a single track of railway should be enough to do the business between the two great oceans, indicates, in language more telling than I can utter, that there must be, in its way as a commercial thoroughfare, practical drawbacks and difficulties of some sort which the world has overlooked. These I have endeavoured to point out.

As a mere pecuniary investment, the Panama Railway has, in spite of its drawbacks, turned out to be a profitable one. But it derives its profits, not from the lap of commerce, as its friends supposed it would, but chiefly from the transportation of passengers, mails, and express parcels. Open the "Transit Route of Nicaragua," and that will give a new vent to commerce, besides attracting trade that Panama can never win; it and the Panama route will act and re-act favourably upon each other.

For reasons of State, her Majesty's Government should encourage this work. Nationally, it is of great importance. But upon this aspect of the case it would be out of place for me to dwell.—Respectfully, etc., etc.,

M. F. Maury.

30, Harley-street, Cavendish-square, July, 1866.

Part II.

Central America.

In defining the boundaries of Central America, I shall not restrict myself to the narrowest part, commonly called the Isthmus of Panama, but include the entire country, from the first narrowing of the lands of North America at the Isthmus of Tehuantepec, between the 16th and 18th parallel of north latitude, and 94th meridian of west longitudes, to its expansion into South America at Darien in the 7th parallel of north latitude and 77th west meridian. In this definition I have been guided, not by political divisions, but by what appear to be the strict geographical limits of the centre of the New World.

Central America, then, lies between the 7th and 18th parallels of north latitude, and the 74th and 94th of west longitude; its least breadth from sea to sea is 27 miles at lat. 9° N., long. 79° W. The extent of its coast line, counting all its sinuosities, is about 3,000 miles, its length from end to end about 1,350 miles, its direction north-west and south-east, and its area about 300,000 square miles, or about the size of Great Britain and France put together.

Suez and Panama.

It is hardly possible to conceive anything more widely different than the nature of the connecting links joining together the continents of the Old and New Worlds. In the former we have a broad, flat, low expanse of parched and arid country, rather more than 70 miles across—a complete desert; in the latter, a mountainous surface, and very irregular coast line, extending over many hundreds of miles, teeming with animal and vegetable life, and only, at its narrowest part, about half the width of the Old World Isthmus. There is another striking dissimilarity—the one possesses the earliest records of the human race in readable hieroglyphics, and is crowded with historical associations of the deepest interest to mankind, whilst the other is a comparatively modern addition to the history of the world, with writings still an enigma to science.

States and Provinces.

There are so many well-written accounts of Central America, from its conquest and partial occupation (the first European settlement was formed by Columbus in 1502), until the final expulsion of the Spaniards, between the years 1820 and 1823, that it seems superfluous to enter upon its earlier history; and I shall, therefore, simply confine myself to a brief notice of the various States and dependencies.

Within the limits I have defined as the natural boundaries of the centre of the New World are included two provinces of New Granada (Panama and Veraguas, commonly called the Isthmus of Panama), two of Mexico (Yucatan and Chiapas), an English colony (Belize, or British Honduras), five republics (Costa Rica, San Salvador, Honduras and the Bay Islands, Guatemala, and Nicaragua), and the Indian kingdom of Mosquito. The five republics number altogether forty-five districts, each with a capital, and 253 towns and villages, exclusive of capitals. Costa Rica has 8 districts; San Salvador, 4; Honduras, 12; Guatemala, 13; and Nicaragua, 8, making in all 45, while the population living within this area is not less than two million souls, or only 7 to the square mile of 640 acres, thus leaving an ample field for future development.

Transit.

I shall now mention the various schemes of transit by canal, which have from time to time been proposed at and between Tehuantepec and Darien.

In little more than ten years after the first settlement was formed by Columbus, the Isthmus of Panama was successfully crossed by Vasco

Nunez de Balboa (September, 1513), who, rushing up to his breast in the water of the Pacific, took possession of that mighty ocean in the name of his master, the King of Spain. From that period, the outline of the Pacific coast, both to the north and south, has been rapidly delineated on the charts, and a glance is sufficient to show how narrow a strip of land intervened at more than one point between the oceans. Then arose the desire to find a practicable route from sea to sea; and as commerce and colonisation increased, doubtless every effort was made by the early conquerors and their followers to discover such an opening, but entirely without success as regards a water passage. In the town library at Nuremberg is preserved a globe made by John Schöner in 1520, on which a passage through the Isthmus of Darien is carefully delineated. Owing to the extraordinary jealousy of the mother country, but little has ever transpired as to the nature of the explorations made with a view to transit by the early conquerors; and the first authentic account of the nature of the overland passage from sea to sea was obtained from the buccaneers, from whom that most remarkable man, William Paterson, one of the founders of the Bank of England, gleaned the information which enabled him to propound a project which was the grandest conception, as it was the greatest national misfortune, of the seventeenth century. Paterson's noble project of opening a "highway of nations" was basely and treacherously ruined, and the idea was not revived until after the Spanish American colonies had thrown off the yoke of the mother country; then, indeed, a host of plans were formed for joining the two oceans.

Tehuantepec.

Fernando Cortez was the first who gave his earnest attention to the search for a practicable route from sea to sea. In his admirable letter to the King of Spain this passage occurs:—"It is the thing above all others in this world I am desirous of meeting with, on account of the immense utility which I am convinced would result from it." Cortez appears to have concentrated his attention upon the isthmus at Tehuantepec, and so great was his confidence in the belief that at this part of Central America the problem would be solved, that he selected the lands in the vicinity as his portion of the conquered country.

After the death of Cortez, the idea of forming a passage from sea to sea, across the Isthmus of Tehuantepec, appears to have been abandoned; indeed, the jealousy and bigotry of the conquerers seems to have caused a reaction in favour of closing every avenue of approach to the New World, instead of opening new roads through it. The learned divine, P. d'Acosta, writing in 1588, says:—"I am of opinion that no human power would be sufficient to cut through the strong and impenetrable bounds which God has put between the two oceans, of mountains and iron rocks, which can stand the fury of the raging seas; and, if ever possible, it would appear to me very just to fear the vengeance of heaven for attempting to improve the works which the Creator, in His Almighty will and providence, ordered from the creation of the world." It is not a little curious that exactly 200 years later (1788) another divine, the Cura of Darien, secured to himself the honour of making a water communication from sea to sea, at the southern extremity of Central America, by a shallow canal from the water of the Atrato to the head waters of the Nipipi, which empties itself into the Pacific. The ruins of the canal could be plainly traced some 30 years ago, when I was engaged in the survey of the Bay of Panama.

In 1814, the Spanish Cortes authorised the formation of a canal across the Isthmus of Tehuantepec in preference to Nicaragua or Panama. In 1842, the Provisional President of Mexico, Santa Anna, granted to Don José de Garay, the exclusive privilege of using steam locomotive power for transit across the isthmus, and that gentleman caused the most elaborate surveys of the route to be made; but the length of the line, the poorness of the ports at each extremity, and the distracted state of the country, combined to deter capitalists from embarking on such an undertaking, and consequently nothing has been attempted. Dampier, Don Augustin Cramer, and the great Baron von Humboldt, have at various times spoken in favourable terms of this route. The latter writes: "We cannot doubt that this point of the globe deserves no less attention than the Lake of Nicaragua."

A canal across the Isthmus of Tehuantepee would be at least 140 miles in length, the summit to overcome would be 656 feet, while the estimated cost reached nearly four millions sterling, and that without including the formation of harbours on either side; the actual sea approaches being mere roadsteads. The grants for opening a canal across Tehuantepec (1842) was the first concession of any Spanish American Republic for crossing the country.

Nicaragua.

The Nicaraguan project has been upheld by many first-rate men, Baily, Stephens, Kelley, and others. In 1830, a company was formed in Holland, under the patronage of the King, for making the canal, but the disturbances in that country broke up the company. Again, in 1835, the project was brought before the Government of the United States, and a resolution of the Senate was passed in favour of it; but the agent sent by General Jackson, then President, to arrange with the Nicaraguan authorities, died on the road, and the matter was allowed to drop. No one, however, has taken so warm an interest in the subject as the late Emperor of the French. It appears that Don Francisco Castillon, envoy to the Court of France, put himself, in 1840, in communication with Prince Louis N. Bonaparte, at that time a prisoner at Ham, and proposed to him, in the name of the Nicaraguan Government, to take upon himself exclusively the construction of the proposed canal. After his escape from Ham and safe arrival in London, he devoted a considerable amount of time and study to it, and not only wrote a most able pamphlet, but publicly advocated the project at the Institution of Civil Engineers, in 1847.

I have made careful extracts from the valuable notes of the Emperor Napoleon III., and have no doubt that a reproduction of those extracts in this place will be agreeable to our members, and prove

an addition to the pages of our *Journal* of no mean value, not only to its readers, but to the advantage of the Society itself. The extracts will be found farther on.

In the years 1837 and 1838, a survey was made by Mr. John Baily, lieutenant in the Royal Marines, at the request and under the authority of General Morazan, then President of the Central American Republic, for the purpose of ascertaining the practicability of forming a canal from the port of San Juan del Sur, on the Pacific Ocean, in lat. 11° 15′ N., long. 86° 1′ W. by the Lake of Nicaragua and the River San Juan, to the Atlantic.

The port of San Juan del Sur is narrow at the entrance, but widens within the harbour; it is surrounded by high land except from west-south-west to west-by-south; the depth of water at the entrance is three fathoms, and its width 1,100 yards. Ships can go up for about half-a-mile, but as the winds often blow with great violence from the north and north-east, there is sometimes considerable difficulty in making the anchorage.

From this port Mr. Baily took a line of levels, not in a direct course, but diverging, so as to pass between the hills at the lowest point, when it could be done without widely deviating from a straight line, and in many places he passed through ravines of from 30 feet to 120 feet in depth. Mr. Baily found the ground rise, with a gradual acclivity, from the beach to the distance of 5,880 yards, where it attained a height of 284 feet, then for 904 yards it rose rapidly to the summit 615 feet above the level of the ocean.

The ground then descended rapidly, and in a distance of 8,664 yards, the elevation was reduced 295 feet, whence it gradually sloped with but slight interruptions for a further distance of 6,168 yards, where it joined the River Lajas, along which it ran for 6,792 yards, and afterwards discharged itself into the Lake of Nicaragua. The surface of that lake was 128 feet 3 inches above the level of the sea; the whole distance from the South Sea to the lake, by Mr. Baily's track, being 28,408 yards, and his mean course N. 33° E.

The dimensions of the Lake of Nicaragua are variously given by different writers; but Mr. Baily seems to have taken some pains to ascertain them exactly, and he states the length to be 95 miles, the breadth in its widest part to be about 53 miles, and the average depth of water, according to his soundings, 15 fathoms. These dimensions agree with the map of Don Felipe Bouza.

The length of the river San Juan, with all its surroundings, from the lake to Grey Town, is 119 miles, with a fall of 107½ feet. There are four rapids, viz., Machula, Castillo Viejo, El Nuco and del Toro, extending over about six miles, with broken water running over a rocky bottom. The San Jaan is fed by many tributaries, the largest of which are San Carlos and Serapique, taking their rise in Costa Rica. The volume of water in the San Juan varies of course in different seasons; at the commencement of June, the lowest stage, about 12,000 cubic feet per second passed from the lake. The greatest rise in the lake ever known was six feet. At high lake, about October, there is probably about 40,000 and 50,000 cubic feet per second, divided at the delta of the river, of which about three-fourths pass out by the Colorado branch, and the remainder by the San Juan.

The whole length of the canal, from the Lake of Nicaragua to the Pacific, is fifteen miles and two thirds. According to the plan, in the first eight miles, only one lock is necessary; in the next mile, sixty-four feet of lockage are required; in the next three miles there are about two miles of deep cutting, and one mile of tunnel, and then a descent of 200 feet in three miles by lockage to the Pacific.

Thus far of the canal across the isthmus.

The Lake of Nicaragua is navigable for ships of the largest class down to the mouth of the River San Juan (where it quits the lake). This river has a fall of one foot and six-sevenths per mile to the Atlantic. If the bed of the river cannot be cleared out, a communication can be made either by lock or dam, or by a canal along the bank of the river. The latter would be more expensive, but on account of the heavy floods of the rainy season it is preferable.

The total length of the canal from sea to sea would be little short of 200 miles, viz., 15⅔ from the Pacific to the lake, 56½ across the lake, and 119 to the Atlantic; total, 191 miles.

The estimate is—

From the lake to the west end of the tunnel	£1,500,000
Descent to the Pacific	500,000
From the Atlantic by canal along the river	2,500,000
	£4,500,000

Darien.

The remaining project takes one starting point, namely, the River Atrato, which is ascended for some distance and then quitted for one of its affluents, the Naipipi, or Truando, for example, whence it is proposed to cut a canal to Cupica Bay or Kelley's Inlet, near the Bay of Panama. Other projectors prefer continuing along the Atrato until its shallows are reached, and thence cutting a canal to the deep waters of the San Juan, which empties itself into the Pacific at Point Chirambira. This last was Humboldt's favourite project, and this is the point where the passage from sea to sea has been made, as described by him in his "Travels." It appears that the Padre of the district, in 1788, induced his Indian converts to cut a trench between the head waters of the San Juan and the upper stream of the Atrato, through the ravine De la Raspadura, and that he actually passed from ocean to ocean in a canoe during the rainy season. The cut is about three miles in length, and has been neglected of late years, but I was informed by the Alcalde of the place, when I was surveying about Cupica in 1847, that he had himself paddled through the cut. The total distance from sea to sea, from the mouth of the San Juan to the mouth of the Atrato, is about 225 miles.

At a later date (1854-5), an American gentleman, named Kelley, entered warmly into this matter, and spent large sums of money in regular surveys and explorations. As Mr. Kelley's efforts at canalisation have been most systematically carried out, and his surveys and estimates contain some sound information, I insert a few extracts.

The line will proceed direct south from the Bay of Candelaria, up the Atrato to its junction with the Truando, lat. 7° 15′ N. and long. 77° 8′ 32″ W. a distance of 67 miles 1,436 yards, whence it will diverge by the Truando to the S.W. and terminate at Kelley's Inlet, lat. 6° 57′ 32″ N. and long. 78° W. a distance of 63 miles 1,216 yards. It will

thus have a total length of 131 miles 892 yards from sand bar to sand bar, with a minimum width and depth throughout of 200 and 30 feet respectively.

The difference in the height of the tides at the two extremities of the proposed route has been ascertained to be, at the entrance of Kelley's Inlet in the Pacific, 12 feet 6 inches at spring tides, and 10 feet 11 inches at neap tides; while the tidal rise at the mouth of the Atrato never exeeeds two feet at any phase of the moon.

Colonel Lloyd estimated the mean level of the Pacific at 3·52 feet above that of the Atlantic; and more recently, M. Garella fixed it at 9·54 feet. Now, from a series of careful observations made in 1855 by Colonel Totten, the engineer of the Panama Railway, in Navy Bay, on the Atlantic side, and the Bay of Panama, on the Pacific, it results that the difference, if any, is exceedingly trifling. Colonel Totten says in his report, "Although my observations make the mean level of the Pacific from 0·14 to 0·75 feet higher than the mean level of the Atlantic, this is probably owing to local circumstances alone. I think I may therefore state that there is no difference between the mean levels of the two oceans."

General Considerations.

You have now before you an account of Central America in general outline, and the three several points of vantage across which canals have been proposed somewhat more in detail; it only remains to choose between the rival proposals.

If we are to have a Central American Canal at all, there seems no reason to doubt that the choice will fall upon Nicaragua, for the general consensus of opinion appears unmistakably to incline in that direction, and most certainly no valid reason has been given against the adoption of that route by any one practically acquainted with the locality; on the contrary, the Americans, who certainly are the best judges, have made up their minds that Nicaragua offers the best, if not the only practicable passage for a canal across the Isthmus.

The English, unquestionably, will in no shape attempt to thwart this decision; indeed, in my opinion, we should do well to accept the situation with this proviso only, that the Nicaraguan Canal must absolutely be neutral territory, open to all comers, entirely unrestricted as a "highway of nations."

As with Suez, so with Nicaragua; if English commerce did not pass along the canal, it could not be made to pay any dividend on the capital required, and, therefore, it would be indeed lamentable if our Government allowed Quixotic notions, such as prevailed in 1846 with regard to free trade, to influence them in allowing English money to gravitate towards paying for the construction of the Nicaraguan Canal, so far, at least, as they can stop it, without taking very good care to have a *quid pro quo*.

Until a proper understanding is arrived at with the United States, ensuring us against the possibility of finding, some fine day, when we are least prepared for such an emergency, that the Monroe doctrine has been brought into play against English shipping, it will be politic to hold aloof from any participation in the undertaking. At the present moment, all the approaches to the Pacific are practically in the hands of the United States. In proof of this, it is only necessary to mention, that had it been necessary to telegraph to our squadron in the Pacific two years ago, the sudden declaration of a war, that message would not have reached the British commander until his men-of-war had been captured in detail, and the capital of Vancouver's Island, with the munitions of war stored at Esquimalt bombarded and probably destroyed, to say nothing of the complete annihilation of our grain fleet, numbering not less than a thousand ships, freighted to convey to our shores the staff of life, amounting to nearly a million tons, not *quarters*, of wheat. Surely, with such gigantic, if not vital, consequences at stake, our Government will awake to the necessity of coming to a clear understanding with that of the United States before allowing the gate of the Pacific, now slammed in our face, to be also barred against us, in default of our intelligent participation in the enterprise of cutting a canal between the Atlantic and Pacific Oceans.

With regard to French interests, M. de Lesseps has made a mistake, which we may be sure, from the generous nature of his character, he will speedily rectify—he has simply followed a portion of the advice of my old friend, the far-famed Baron von Humboldt, in a letter to Mr. Kelley, of which I extract the following paragraph:—

"The great object to be attained is, in my opinion, a canal which would unite the two oceans without locks and without tunnels. When the plans and sections can be placed before the public, a free and open discussion will elucidate the advantages and disadvantages of each locality; and the execution of this important work, which interests the civilised nations of the two continents, will be entrusted to engineers who have successfully distinguished themselves in similar enterprises."

M. de Lesseps is the last man to be discouraged by a failure; probably he already feels that he had better have relied on his own undoubted genius or followed up the proposals of his great and good patron, the late Emperor Napoleon III, whose wisdom and forethought are now conceded on all sides; indeed, I cannot do better than conclude this part of my subject by publishing, after long and close study, the views and opinions of that sagacious monarch on the Nicaragua Canal.

I quote from a very rare paper, written by the late lamented Emperor; the extracts will, I am sure, find an honoured place in the pages of the *Journal of the Society of Arts*.

Extracts from a Pamphlet written in 1847 *by Napoleon III.*:—

"There are certain countries which, from their geographical situation, are destined to a highly prosperous future. Wealth, power, every national advantage, flows into them, provided that where nature has done her utmost, man does not neglect to avail himself of her beneficent assistance.

"Those countries are in the most favourable condition which are situated on the high-road of commerce, and which offer to commerce the safest ports and harbours, as well as the most profitable interchange of commodities. Such countries, finding in the intercourse of foreign trade illimitable resources, are enabled to take advantage of the fertility of their soil; and in this way a home trade springs up commensurate with the increase of mercantile traffic.

"It is by such means that Tyre and Carthage, Constantinople, Venice, Genoa, Amsterdam, Liverpool, and London attained to such great prosperity, rising from the condition of poor hamlets to extensive and affluent commercial cities, and exhibiting to surrounding nations the astonishing spectacle of powerful States springing suddenly from unwholesome swamps and marshes.

"Venice in particular was indebted for her overwhelming grandeur to the geographical position which constituted her for centuries the *entrepôt* between Europe and the East; and it was only when the discovery of the Cape of Good Hope opened a ship passage to the latter that her prosperity gradually declined. Notwithstanding, so great was her accumulation of wealth, and consequent commercial influence, that she withstood for three centuries the formidable competition thus created.

"There exists another city famous in history, although now fallen from its pristine grandeur, so admirably situated as to excite the jealousy of all the great European powers, who combine to maintain in it a Government so far barbarous as to be incapable of taking advantage of the great resources bestowed upon it by nature. The geographical position of Constantinople is such as rendered her the queen of the ancient world. Occupying as she does the central point between Europe, Asia, and Africa, she could become the *entrepôt* of the commerce of all these countries, and obtain over them an immense preponderance, for in politics, as in strategy, a central position always commands the circumference.

"Situated between two seas, of which like two great lakes, she commands the entrance, she could shut up in them, sheltered from the assaults of all other nations, the most formidable fleets, by which she could exercise dominion in the Mediterranean as well as in the Black Sea, thereby commanding the entrance of the Danube, which opens the way to Germany, as well as the sources of the Euphrates, which opens the road to the Indies, dictating her own terms to the commerce of Greece, France, Italy, Spain, and Egypt. This is what the proud City of Constantine could be, and this is what she is not, because, as Montesquieu says, "God permitted that Turks should exist on earth, a people the most fit to possess uselessly a great empire.

"There exists in the New World a State as admirably situated as Constantinople, and we must say, up to the present time, as uselessly occupied: we allude to the State of Nicaragua. As Constantinople is the centre of the ancient world, so is the town of Leon, or rather Masaya, the centre of the new; and if the tongue of land which separates its two lakes from the Pacific Ocean were cut through, she would command, by her central position, the entire coast of North and South America. Like Constantinople, Masaya is situated between two extensive natural harbours, capable of giving shelter to the largest fleets safe from attack. The State of Nicaragua can become, better than Constantinople, the necessary route for the great commerce of the world; for it is for the United States the shortest road to China and the East Indies, and for England and the rest of Europe, to New Holland, Polynesia, and the whole of the western coast of America.

"The State of Nicaragua is then destined to attain to an extraordinary degree of prosperity and grandeur, for that which renders its political position more advantageous than that of Constantinople, is that the great maritime powers of Europe would witness, with great pleasure, and not with jealousy, its attainment of a station no less favourable to its individual interests than to the commerce of the world.

"France, England, Holland, Russia, and the United States have a great commercial interest in the establishment of a communication between the two oceans; but England has more than the other powers a political interest in the execution of this project. England will see with pleasure Central America becoming a flourishing and powerful State, which will establish a balance of power by creating in Spanish America a new centre of active enterprise powerful enough to give rise to a great feeling of nationality, and to prevent, by backing Mexico, any further encroachment from the north. England will witness with satisfaction the opening of a route which will enable her to communicate more speedily with Oregon, China, and her possessions in New Holland. She will find in a word that the advancement of Central America will renovate the declining commerce of Jamaica and the other English islands in the Antilles, the progressive decay of which will be thereby stopped.

"It is a happy coincidence, that the political and commercial prosperity of the State of Nicaragua is closely connected with the policy of that nation which has the greatest preponderance on the sea."

In the remainder of his pamphlet, after fully considering the cost of the land, the Emperor enters at length upon his plan for combining colonisation with the canal undertaking. The main features of this plan are well worthy the most careful consideration, and are here produced:—

"We have stated that the secondary profits of the canal would arise from the increase in the value of the soil. According to our information, the Government of Nicaragua would cede to the company all the land lying on the right and left banks of the canal throughout its entire course, to an extent of two leagues inland, forming three hundred square leagues, or about 1,200,000 acres. These 1,200,000 acres are at the present moment worth 1s. 6d. per acre. The proposed gift by the Government of Nicaragua to the company is, therefore, now of the value of £90,000. If we deduct from the above number 200,000 as probably incapable of cultivation, and 300,000 more that would be required for the service of the company, producing no income, or as concessions to its engineers, servants, &c., there will remain 700,000 acres to explore and improve. The canal being accomplished, it will be easily granted that these lands may in all probability bear a value of £2 per acre.

"£2 per acre. Let us put it at £1 per acre only, and we shall have a property of £700,000, vesting absolutely in the company, for we must not forget that the soil is here very fertile; that they frequently have more than two harvests a-year; that the indigo produced in this country is better than that produced in the East Indies; that the tobacco is as good as that at Bavaria; that coffee and sugar are easily produced; that the forests are filled with Brazil wood; that there are mines to work; and, finally, that the waste water thrown off the canal works, would afford power for manufacturing purposes. It is thus evident that if the company should limit itself to the disposal of these lands when the canal is complete, they would derive great profit, were it only by the increase of value; but in our opinion, there is a greater advantage to be derived from their detention.

"We finally believe that it is important to continue, with the construction of the canal, the project of colonisation, in order that the two undertakings should assist each other, and to enlist as shareholders the mass of emigrants who annually depart for America, and who, according to the statistical information gathered up to this day, set forth with an average sum per head of 20.* Thus the shares would be placed in hands most

* We read in the *Journal des Débats*, of the 3rd May, 1846, that the Society formed at New York, the 31st of March, 1784, to assist the indigent Germans in the United States, had just celebrated the sixty-second anniversary of its foundation. On this occasion they have published a pamphlet, which states, amongst other things, that the number of German emigrants which arrived during the last year, in the City of New York alone, amounted to 30,567, each of them having an average sum of £20

interested in the success of the undertaking; for those who join an enterprise for the sake of investment, and not mere gamblers, ensure the solidity of an undertaking.

"The capital of £4,000,000, which we presume to be necessary for the construction of the canal, should be divided into 400,000 shares of £10 each. By paying down the value of one or more shares, the emigrant shareholder would be entitled on his arrival in America, to such accommodations as would enable him to overcome the first difficulties, necessarily attendant on early steps in colonisation. Every emigrant shareholder would receive from the company twenty acres of land to cultivate, as well as the implements necessary for that purpose.

"The 700,000 acres of land would be thus distributed among 35,000 emigrants, and sold to them on the following terms:—Ten years' time would be allowed for the emigrant shareholder to pay to the company the price of the twenty acres allotted to him, as well as the outlay incurred by the company in procuring him dwelling, food, and all the accommodations required. The payments should be made by annual instalments, and proportionate to the progressive increase of value likely to increase every year in the property.

"So the whole of the first year having been entirely taken up by preparing and tilling the ground, the emigrant shareholder should not be made liable for any payment whatever during that time. The annual instalment should begin to be paid off at the end of the second year, and accomplished in the progressive manner indicated in the following table:—

	Per Acre Per Annum.
At the end of the first year.....	£0 0 0
,, ,, second year.....	0 1 0
,, ,, third year.....	0 1 6
,, ,, fourth year.....	0 2 0
,, ,, fifth year.....	0 2 6
,, ,, sixth year.....	0 3 0
,, ,, seventh year.....	0 3 6
,, ,, eighth year.....	0 4 0
,, ,, ninth year.....	0 4 6
,, ,, tenth year.....	0 5 0
,, ,, eleventh year...	0 5 6
	1 12 6

So every acre of land will procure to the company, in the course of eleven years, a net profit of £1 12s. 6d., and, consequently, 700,000 acres of land will bring, in the above-stated lapse of time, the corresponding profit of £1,137,500.

"The company would establish as many villages as would be necessary for the number of colonists. Each village would be erected on the most healthy spots, and in the vicinity of a river. It would be composed of 200 dwellings, each dwelling being appropriated to one family. A village would then cost:—

200 dwellings, at £4 each.....	£800
Maintenance for the first six months, and seed, at £4 per family.....	800
Church, stores, and schools.....	280
Casual expenses.....	120
	£2,000

"If we divide this sum by the number of families, we shall find that the outlay will be £10 per family, in 10 years, to be reimbursed as above stated. Now, let us suppose that in about 10 years the company has established 175 villages, containing 35,000 families; the expense will have been £350,000, which the company will be reinbursed by the annual progressive rate. As each of these families has been enabled to buy and pay for 20 acres of land, at the progressive rate above mentioned, the company will have received for 700,000 acres, the sum of £1,137,500, from which, deducting £350,000, the outlay for the construction of the villages, there will remain a clear profit of £787,500, exclusive of the interest received on the outlays. We must also remark that the colonists being shareholders, will have paid £787,500 to themselves in their capacity as a company, then there would be a perfect amalgamation of interest between the shareholders and the colonists, who would be equally interested in the success of the undertaking. Thus deducting the sum from the amount of £4,000,000 necessary for the construction of a canal, the capital expended would be about £3,200,000 only, bringing a net profit of £600,000 or 10 per cent. per annum.

"At present, when the colonist goes to America, he finds no dwelling, no advance of capital, and often no employment; on our plan, on the contrary, by means of a share, he is sure to find, on arriving in America, a wholesome dwelling, livelihood for six months, fertile lands, and a community already settled. Moreover, a part of the money paid for the purchase of his land would come back to him as a shareholder, and in about 10 years his property would not only be freed from all burdens, but he might expect at that period, that both his share in the canal and his land would be doubled in value.

"Thus our project protects all interests, the capitalists realises large profits, and the emigrants partake of the benefits with a moral certainty of future prospsrity. This neglected country speedily changes to flourishing towns, its lakes are covered with fleets, and its wealth is increased by the progress of agriculture and commerce."

"Central America can emerge from her present languor, only by following the example of the United States, namely, by borrowing from Europe labour and capital for this their first object. Independent of the advantages of its geographical position, and of the fertility of its soil, the State of Nicaragua presents to European emigrants advantages which are not to be found in the United States. In the North of America, the population settled itself in the beginning on the eastern coast gradually extending inland. As long as the uncultivated lands were not far from the sea, the European emigrants easily found employment, but now the case is altered, and the great number of foreigners that daily arrive in the United States, become for the following reason a burden to the nation. The uncultivated lands, where adventurers may easily find employment, are three hundred leagues from the coast, and as in most instances the emigrants are destitute of means to reach those remote districts, they become in the towns on the coast a prey to indolence and misery.

"In Central America the reverse would be the case; the indigenous population has settled by preference on the coast of the Pacific Ocean, deserting all that part situated opposite the ancient world, so that when the country is in a position to require colonists and European labourers, they may arrive, through the canal, to places already inhabited, and the population will gradually extend from the west to the east, and not, as in the United States from the east to the west, thus getting nearer to Europe in proportion as it increases, and offering facilities to the new colonists, till they reach the extreme borders of the country.

"The prosperity of Central America is connected with the interests of civilisation at large, and the best means to promote the welfare of humanity is to knock down the barriers which separate men, races, and nations. This course is pointed out to us by the Christian religion, as well as by the efforts of those great men who

sterling. Of these emigrants 12,225 arrived from Havre, in 78 ships; 9,647 from Bremen, in 77 ships; 3,718 from Antwerp, in 25 ships; 2,525 from Hamburg, in 24 ships; 1,959 from Rotterdam, in 13 ships; 493 from Ghent, London and Liverpool, in five ships. The greater part took their direction towards the Southern States. In 1814, there arrived only 17,999 German emigrants at New York.

have at intervals appeared in the world. The Christian faith teaches us that we are all brothers, and that in the eye of God the slave is equal to the master, as the Asiatic, the African, and the Indian are alike equal to the Europeans. On the other hand, the great men of world have by their wars co-mingled the various races of the world, and left behind them some of those imperishable monuments, which, in levelling mountains, opening forests, and canalising rivers, has a tendency to upset these obstacles which divide mankind, and to unite men in communities, communities in people, people in nations. War and commerce have civilised the world. The time for war is gone by; commerce alone pushes its conquests. Let us, then, open to it a new route; let us approximate the people of Oceania and Australia to Europe; and let us make them partakers of the blessings of Christianity and civilisation. To accomplish this great undertaking, we make an appeal to all religious and intelligent men, for this enterprise is worthy of their zeal and sympathy. We invoke the assistance of all statesmen, because every nation is interested in the establishment of new and easy communication between the eastern and western parts of the globe. Finally, we call upon capitalists, because whilst they are promoting a glorious undertaking, they are sure to derive a large profit thereby."

Part III.

Personal Explanation.

Before proceeding to place before you the views and opinions which I entertain in respect to cutting a canal across Central America, it is only right that I should indicate the range of my experience, and show cause for the confidence with which I express those views and opinions.

In this respect, I cannot do better than quote from my printed address to the Paris Congress, which I was unable to attend, owing to a severe accident, breaking the left knee-cap, which literally tied me, at that time, by the leg:—

"I may say that between the years 1845 and 1851 I was engaged, 'on and off,' on the surveys of the coast line of the Pacific Ocean, from Cape Corrientes to the port of Realejo, especially in and around the Bay of Panama—a coast of about 1,000 miles—my attention being particularly directed to the Gulf of San Miguel, the approaches of the Nippi, to the Chepo, or Bayano river, a route having the recommendation of possessing a waterway approaching the Atlantic Ocean nearer than any other, and to the magnificent harbour of Realejo in Nicaragua.

"On the Atlantic coast I have had an equal, if not more extensive, experience.

"Between 1859 and 1861 I was stationed as senior naval officer between Cape Gracios a Dios and Colon, or Aspinwall, and since that time I have often crossed Central America. I have been no less than six times through Nicaragua, and possess an accurate section with the theodolite between the Atlantic and the Lake of Nicaragua, on a line parallel to and about 40 miles distant from the river San Juan.

[That section you will see on the wall behind me.]

"I have pointed out fully in my works, 'The Gate of the Pacific, 1863,' and 'Dottings by the Roadside, 1869,' and this meeting is of course aware that there are still other routes to the northward; such as that through Tehuantepec and Honduras, for which latter State I was for some time Special Commissioner, and for more than a year devoted my best attention towards completing the Inter-Oceanic Railway; but circumstances over which I had no control prevented me from achieving that object. I am bound to say, however, that I still have faith in it, and believe the Government of the country would satisfy the just claims of their creditors to the last dollar, if only those creditors would bring a gentle pressure to bear, and insist upon payment, if not in money, then in land, in exchange for their bonds."

Political.

There is a phase of the question before us to-night which must not on any account be neglected, for, after all, it has quite as important a bearing as the physical geography, *plus* the engineering considerations of the enterprise, both put together; I mean the political or diplomatic aspect of the situation. We have now to ask ourselves how far the enterprise of effecting a junction between the Atlantic and Pacific, by means of a canal capable of transporting ships from one ocean to the other, across the Isthmus of Central America, may affect the political relations of the great nations affected by it.

To arrive at a solution of this problem, I must first point out the nature of interest which each of the nations named seems to possess in the proposed enterprise.

In the order of interest I have already adopted, I may point out—1. That a canal across Central America would be the gate of the Pacific to the United States, a gate, moreover, which no American statesman would allow for one moment to be in the governmental keeping of any other country whatever. 2. That England's concern in the undertaking is chiefly to further a supply of cheap grain from California; last year no less than a thousand sailing vessels, averaging 1,000 tons each, rounded Cape Horn, bound for England with a cargo of the "staff of life," and it is obvious that by shortening the passage and avoiding Cape Horn, freights and insurance would rule less, and consequently grain could be placed in the English market at a lower price.

At the same time it may be as well to warn the United States that in this case England's necessity would not be their opportunity, for there are other places besides California from whence we may draw a supply of grain, with far more ease and certainty, and at considerably less cost. The Euphrates Valley, for instance, which in ancient times was the granary of the world, and which England, by merely lifting up her little finger, could, within a very short time, restore to its pristine importance, and that not only in British interests as a great field for British colonists, but eminently in furtherance of her duty, under the secret treaty, by advancing the prosperity and civilisation of Asia Minor.

But taking a broad view of the position, it is quite in accordance with the best interests of the United States to join hand and glove with England in the canalisation of Central America; at all events, without the co-operation of English capital and trade, this is certain, the canal would not prove a paying concern to the United States; indeed, it would take very much the character of a white elephant.

With regard to France, the canal is more a matter of sentiment than a real want, and in point of fact the French people for the next century can afford to remain in blissful ignorance, whether a canal across Central America exists or not. Nevertheless, the proposed work is of a nature to command the respect if not the enthusiasm of the French people, and, therefore, taking all the *pros* and *cons* into consideration, it may be quite worth

the while of France to join with England and America in a sort of co-partnership to make the proposed canal a grand international work. The cordial union of the three nations is very desirable upon every ground, but how is this to be effected. By treaty? Certainly not; for treaties, now-a-days, are only made to be broken.

How, then, can this union be made? Why, in a business-like manner, for business purposes. Let the three nations join hands and become partners for the purpose of carrying out this grand undertaking, and let the three nations weld themselves into one, as it were, by each undertaking a guarantee of 1 per cent. on the capital required.

The requisite money, no matter what the amount, would then readily be raised at 3 per cent., under a joint guarantee of the greatest nations in the world.

Admiral Ammen, U.S.N.

Before placing before you the suggestions I have to offer, it is only fair that I should inform you of the views of the American Government in respect to the Interoceanic Transit, as laid down by Admiral Ammen, at Paris, in May last.

In his address to the Congress, he clearly and unmistakably points to Nicaragua as having the preference, after exhaustive surveys, over every other part of the Isthmus of Central America.

The facts and figures mentioned by Rear-Admiral Ammen are conclusive, as will be seen by the following summary of the information which he gave to the Congress:—

Extracts from the Address of Rear-Admiral Daniel Ammen, U.S. Navy, Vice-President of the Congress, Member of the Inter-Oceanic Canal Commission, appointed by H.E. the President of the United States, in compliance with a resolution of the Congress of the United States of America.

Nicaragua Route.

The rainfall is comparatively small. Our observations at Lake Nicaragua, extending over one year, show an annual rainfall of forty-eight inches, or 1·22 meters. There is a distinct dry season of between five and six months, when work in progress would not be delayed or injured, and but little interruption need be apprehended in the rainy season on that section of canal between the lake and the Pacific, as the rain generally falls at night, with occasional showers during the day.

There is abundant good stone, hydraulic and other lime, wood, and bamboos, which may be found very advantageous in the construction of harbours.

There is a considerable population, well disposed, and when they can have remunerative employment, fairly industrious. The country has an abundant cattle supply of good quality for food, and other productions which would furnish the main subsistence for labourers on the canal, with a convenient water transportation in general along the line of ship canal as located, and lake communication with an extensive, populated, and fertile region. This water communication can be greatly increased, by the construction of a six foot canal to Lake Managua, at an inconsiderable cost, and when completed would make the supplies of all kinds superabundant. Between Lake Nicaragua and the Pacific, near the line of the projected canal, several passable roads exist, and whatever other roads might be required over this short distance could readily be made at inconsiderable cost.

There is an inexhaustible water supply in its lake of 2,800 miles of superfice, which equalises floods and makes the daily changes small in the discharge.

It has an excellent harbour on the Pacific coast at San Juan del Sur, conveneent for anchorage as Brito itself would be improved as a harbour, inasmuch as the vessel in transit would have time to regulate her steam and be pointed fair to enter the canal at any assigned time. This reduces the necessity of a harbour at Brito to simply securing a perfectly smooth entrance to the canal.

Lake Nicaragua affords every facility for an interchange of cargoes that may be desired.

The west coast and the valley of the lake are, as compared with the eastern slope, comparatively healthy, and upon the eastern slope a considerable part of the labour can be done by means of dredging machines.

The approaches to both entrances are superior in advantages to those of either of the two other routes with which the Nicaragua route is compared.

These considerations would seem to warrant the belief that cost of construction, including material, would be far less than upon either of the two other routes compared, as will be more fully shown hereafter.

Panama Route.

The mean annual rainfall at Aspinwall in a series of seven years is found to be 124·25 inches, or 3·15 metres. A dry season exists, but it is limited to two or three months, lessening the effective time for labour and of comparative healthfulness of the labourers employed, the wet being the sickly season.

No building material suitable is known in that region. The ties and railroad telegraph poles on the Panama Railroad are brought from Carthagena or elsewhere.

The population is inferior to Nicaragua in ability to furnish subsistence for a large number of labourers.

By means of the railroad already constructed, a canal under construction would have a convenient transportation at whatever cost might be agreed upon.

The cost of the feeder and adjuncts, as well as other disadvantages, notwithstanding the shortness of the line, as shown by maps, plans, and estimates, make a total of 94,511,360 dols., as against those of the Nicaragua route of 65,722,137 dols. on a common basis of cost of material and labour, when in Nicaragua the material is near at hand and subsistence abundant, and on the Panama route, or in its region, there is no material for construction, inferior subsistence and less favourable climatic conditions for labour, as before stated.

Darien Route.

Although the mean annual rainfall is not known, there is no doubt of the fact that it is largely in excess of the rainfall in Aspinwall, on the Panama route. There is only a nominal dry season, as at any time a precipitation of several inches is likely to occur, and actually does occur many times yearly during the so-called "dry season."

The building material supposed to be available is confined to wood.

The population is so scant as to be unable to furnish either assistance or subsistence for even an inconsiderable number of labourers.

The River Atrato would furnish transportation to the mouth of the River Napipi. Along the line of the projected canal the country is alternately rough and covered with swamps, so that great labour would be necessary to construct roads to secure even wagon transportation, for subsistence, and material for construction.

Under such conditions the projected feeders requisite would be made at great additional cost, as well as the projected tunnel and locks. In dimensions the projected tunnel is as follows:—Length, 5,633 metres; height, 35·96 metres; width, 18·29 metres.

On the Atlantic slope there are twelve projected locks of 3·14 metres lift, and on the Pacific slope ten of 4·54

metres lift, the summit level being 43·59 metres above mean tide.

With the view of having a definite comparison, the estimate for material and labour, so far as they are identical, were made on a common basis with Nicaragua. The cost of this basis is given as 98,196,894 dollars, but it is quite apparent that with the lack of material convenient of subsistence and transportation, as well as the absence of a dry season, and, above all, the impossibility of making even an approximate estimate of the cost of a tunnel under such conditions, that the actual cost of the execution of the work would be far in excess of the estimate.

The same physical conditions—the absence of a dry season and a general lack of material for construction, except wood, and the lack of subsistence—were found to exist by all our parties at various times on what is known properly as the Isthmus of Darien and of all the region lying south of it.

It is impossible not to be struck with the common sense of these remarks of Admiral Ammen. I know the Napipi, I know Panama, and I know Nicaragua, and I cordially endorse the American preference for the latter.

Suggestions.

I have now to offer a few suggestions, and propose a plan by which I hope to aid those who will embark in the enterprise of constructing a canal, through Nicaragua, from the Atlantic to the Pacific.

The great difficulty to be overcome in the construction of a canal across Nicaragua is the making and maintaining the harbour of Greytown, on its Atlantic terminus. My friend, the late Mr. Robert Stephenson, the great engineer, when I was with him in Egypt in 1858, used to say that he was acquainted with the deltas of all the great rivers of the world, but that he was not aware of a single instance in which a harbour was maintained at the mouth of any of such rivers. Now, the River San Juan de Nicaragua has a delta at its mouth, but no other delta in the world is so capricious. In 1856, a squadron of H.M.'s ships rode securely at anchor in the harbour of Greytown; but in 1860, when I was stationed as senior naval officer in that locality, the sand-bar, which made the harbour, stretched across very nearly from shore to shore, leaving only sufficient depth of water for the very smallest coasting craft. A few years later there was again a considerable opening, and so matters went on, but now for some time it has been completely closed. A strong norther is sufficient to shut up the harbour, while a high river will re-open an entrance. Mr. Robert Stephenson's dictum, therefore, as to the enormous difficulties to be encountered in the attempt to form a harbour at the delta of any great river, is more than borne out in the case of Greytown.

I am well aware that an exception has occurred to this ruling in the case of the Mississippi, where Mr. Eads has succeeded in obtaining a depth of twenty-seven feet, under high pressure from Congress; but the problem is, how to maintain that depth at anything like a paying cost. If the engineering difficulties could be overcome, in forming and maintaining a harbour at Greytown, the other obstacles to the opening of the canal from ocean to ocean would be found of secondary importance, although it cannot be denied that the River San Juan is more or less encumbered with shoals and rapids, and with sudden rises in the rainy season of from 20 to 40 feet, making the control difficult; but to my mind Greytown itself would alone completely swamp the enterprise. Under these circumstances it seems desirable to suggest an alternative route, with very different dimensions for the canal, and a consequent diminution of cost from that at present contemplated.

Starting from Monkey Point, now called Pim's Bay, on the Atlantic, 40 miles north from Greytown, I should commence by cutting a canal from the inner part of that bay down to the Rama river, a distance of about 10 miles. The Rama river itself carries deep water about twenty miles into the interior; the remaining seventy miles to the Lake of Nicaragua would traverse land, offering no particular difficulty, as may be seen by the section which is suspended behind me.

From San Miguelito, on the Lake Nicaragua, by way of Tipitapa, to the northern shores of Lake Managua, there is nothing which an engineer would consider a difficulty in these days. The remainder of the canal to the *embarcadero* of Port Realejo, on the Pacific, can scarcely be said to afford a field for engineering skill, the great difficulty being the supply of water for the canal, but, inasmuch as Lake Managua is higher than the Pacific, this is not insurmountable. The distances by this route would be as follows:—

	Miles.
Pim's Bay to Lake of Nicaragua	100
Lake Navigation	85
Rio Panaloya or Tipitapa	20
Lake Managua	40
Lake to Realejo	45
	290

occupying, at four miles an hour, say, three days.

I must point out that, in this scheme, a deep-water canal is not even contemplated; a depth of eight feet would be amply sufficient, the vessels being raised and transported on pontoons by the process which has been successfully used in the Victoria Docks for years. A ship of the largest tonnage is raised within half an hour, and the pontoon, only drawing four feet of water, is hauled, with the ship securely resting upon it, into a shallow dock for its reception. It is needless to say how considerably the cost of the canal works would be reduced if such a plan were adopted, while there are other advantages, such as cleaning the ship's bottom *in transitu*, just as if she were in dock, the doing of which would effect a saving to the owners, by increase of speed, almost, if not quite sufficient, to pay the canal dues.

Another suggestion I wish to make is this: first open in the proposed direction a complete transit from Pim's Bay to Realejo by means of a railroad and lake steamers. It must be apparent how materially this would cheapen the canal works, if only by enabling the engineers to avoid many an obstacle which, without such a pilot, would be sure to crop up and impede the works. Besides, such a transit would, I have reason to believe, earn enough to pay interest on the canal capital within a year of its construction, and I believe that the works of the railroad, a light single line, might be finished in about a year after turning the first turf. The advantages to be gained by adopting

the plan I have just proposed seem to me obvious; but I will go even farther, and suggest that this railroad, from Pim's Bay to the Lake of Nicaragua, should be built, even if the canalisation of the River San Juan is determined upon, because then the engineers could be supplied with all their requirements with the stream instead of against it.

An estimate is always a delicate matter to deal with, and I shall not attempt to go into detail, but take the outside sum of £20,000 a mile, and the outside length of my proposed route at 300 miles, upon nearly one half of which distance no outlay will be needed, so that practically, my estimate is £40,000 a mile; the total sum required would then amount to six millions as the outside cost of a water communication from ocean to ocean, including the pilot transit I have already mentioned.

I do not believe there would be any difficulty in raising six millions sterling in America, England, and France, for such purposes, if only a land warrant for a five acre plot were given as a bonus with each £10 share. This would necessitate a grant of land with the concession of some 5,000 square miles on each side of the Canal of Nicaraguan territory, between the Atlantic and the Lake of Nicaragua, and would, no doubt, be readily given. But I think it will be admitted by everybody, that such a work as joining the Atlantic and Pacific Oceans should not be left to private enterprise. It is surely a work of sufficient magnitude to enlist international support, especially if that support can be shown to require a pecuniary outlay only of the smallest dimensions, and that only for two or three years.

Let us assume the capital to be, as I said just now, six millions. Now, if England, America, and France, would join hands, and each guarantee 1 per cent on that amount, we should have a joint guarantee of 3 per cent.—inducement sufficient for English investors alone to take up the whole sum in less than a week. What is 1 per cent. on £6,000,000? £60,000 a year—a sum, I venture to think, annually wasted on any vote exceeding one million of the Navy estimates. And what do we get for our money? Why, at the least, a consolidation of the friendly feeling between this country, the United States, and France, far more lasting and binding than could be effected by any treaty merely guaranteeing the neutrality of the route. We should be joint proprietors of the canal, and that, in my judgment, is the only safe arrangement to be made, considering the tremendous stake involved.

Conclusion.

In the preceding remarks, I have endeavoured to place before you a bird's-eye view of the efforts which have been made, notably by the Paris Congress, to resuscitate the project of cutting a canal across the Isthmus of Central America; I have also tried to give you a general idea of Central America itself, and the various proposals made to effect a junction across it: and I have pointed out why the isthmus at Nicaragua is more favourable for the construction of a canal than at Panama; finally submitting to you my own plans and proposals based upon long practical experience on the spot. At last the day appears to have arrived, for which I have worked hard for twenty years at no mean expenditure of time and money.

If the Government is blind to British interests and has lost that spirit of enterprise through which our forefathers raised the nation to its present greatness; if the Government neglect to take up a proper position towards a project so closely interwoven with the future of the United Kingdom, then such degeneracy must be deplored, and theirs is the responsibility.

My interest in Nicaragua, or rather Mosquito, is as great as ever; I still own considerable property there, many thousand acres of land, and the freehold of the Atlantic Terminus at Pim's Bay, but I say now to the present Government, as I wrote to that of 1859, and recorded in my book, "The Gate of the Pacific," published in 1863, that I simply hold this property in trust for the national benefit, and my great ambition is that it may prove useful to further the prestige and maintain the power of old England.

DISCUSSION.

Mr. Cornelius Walford said he had been familiar with the different projects for a canal across this isthmus for the last 20 years. He had read Captain Pim's first book upon it, and every report published since. He had also conversed with M. de Lesseps, and he had long hoped that this scheme would assume the position which it was now, he trusted, about to take in the public mind;—that some step would in fact be taken to show that in this case England did not make the same mistake she did with reference to the Suez Canal, and follow the same do-nothing policy. It was due almost entirely to one man, the late Lord Palmerston, that England took no part in that great work; but although a Liberal Minister had done so much to stop the progress of commerce in that direction, he was glad to say that another Minister since had done something to help us out of the condition into which we had fallen. He was sure the time would come when the Society of Arts or some other Society would take steps to see that this scheme was placed well before scientific and financial men, and that England would have an opportunity of showing some regard for the construction of that canal, the best mode of constructing it, and the uses to which it should be applied. Captain Pim's scheme appeared to be a very good one. Reference had been made to the supposed differences of level between the Mediterranean and Red Seas as an objection to the Suez Canal; but he had lately been visiting the great lakes of America, which differed in level 40, 50, or 60 feet, and by the construction of locks, there was practically no difficulty in passing from one to the other; so that, even if there were these difficulties, they would be no argument against the scheme going forward. Captain Pim had shown that there was a feasible scheme, and he only hoped that it would be carried out.

Mr. Trelawney Saunders said he had taken great interest in this subject for many years, and therefore, could not refrain from saying a word or two upon it. Capt. Pim had told them that he had explored the coast of this remarkable isthmus on both sides, and they knew that various attempts had been made to explore the interior along various lines, but it struck him that if they were to undertake a work of this kind as an international scheme, the three great nations setting about it should not commit themselves to any project whatever unless they had a thorough survey, not only of the ports and coast on each side, but also a complete examination of the interior of the country, so as to lay bare the whole of the facilities and difficulties wherever they existed. This

had not yet been done. The various schemes urged upon the notice of the public were merely local schemes, based more or less on local observation, leaving them still in the dark as to the other parts of the isthmus that remained still unsurveyed. Lieutenant Wise, who represented a family interest in the scheme proposed by the late Emperor Napeleon, went out to the Isthmus of Darien for the purpose of making a particular survey of that portion, but entirely failed in accomplishing his object. The scheme he set before the public was one based upon his observation, from an accessible hill near the the coast, of a depression in a mountain range, which depression he never explored. He (Mr. Saunders) would repeat that a thorough trigonometrical survey and levelling of the isthmus was the first step to be taken after the determination of the maritime question, before any further conclusion could be arrived at with regard to the practical cutting of an interoceanic canal. He thought that everyone must agree with this conclusion, and he hoped that this would not be a damper upon the project of Captain Pim, for he felt sure he would himself allow the desirability of accomplishing, in the interests of science and of the object in view, such a great work as the survey of the district would be. It ought not to be a work of great difficulty; the area was not great, and was easily accessible at every point. The only difficulty, he was informed, arose from the remnants of the ancient native tribes, who were supposed to have found their permanent refuge not far from the Panama Railway. The making of such a survey would of itself attract public attention to the subject, and give that confidence which was so necessary to enable them to enter with any spirit upon such an enterprise.

Mr. Christopher Cooke said that, as long ago as June, 1847, there was a discussion at the Institute of Civil Engineers on this subject, when it was stated, by Mr. Glynn, that the distance across the isthmus was 39 miles, and it had been surveyed in 1828 by Mr. Lloyd, who determined the difference of level between the two oceans to be only 3½ feet. He also referred to another French survey in 1846, which confirmed the view that there were no engineering difficulties.

Mr. O'Clery, M.P., said it had been rumoured for some considerable time past that the United States Government was opposed to the scheme of the Panama Canal, and he should like to know if it were the fact that the Government was favourable to a canal through Nicaragua, because the first practical step to be taken would be to reconcile the United States Government to this great object.

Mr. Robert B. Buckley said, as an engineer of some experience in the making of canals, he should like to ask Captain Pim one or two questions. He understood that the canal was to be supplied with fresh water, admitted in the higher levels, and that the two sides of the canal sloped down on either side, and would have to be worked by locks. He should like to kuow from what source the water to feed the canal would come. He understood that the rainfall in the district was only 48 in., as compared with 120 lower down the isthmus, and that nearly all the rain fell in some three or four months. He should therefore think it probable that in the dry season the supply available for the canal would be small, and hardly sufficient. He had seen a canal taken off from one of the largest Indian rivers, the Sone, which had a discharge in the rainy season of 750,000 feet a second, so dry in the hot season that the navigation was completely stopped. Another question of importance was the soil through which the canal was to be cut; was it sand or clay? If the soil were sandy, the supply which would be necessary to keep it open would be very large indeed at first. He had seen a reach of canal only six miles long require 150 feet of water per second to keep it open for the first few days after water was let in. The third question was with regard to the pontoons, on which he understood it was proposed to carry the ships through the canal. Did the estimate of six millions include these pontoons? because it seemed to him they would form a very important item. If there were only ten ships a day, and they each took four days to pass through, forty or fifty pontoons would be required, and as he supposed that vessels of 4,000 tons would use the canal, the pontoons would have to be of large size, and would probably cost something like £20,000 a piece, or a £1,000,000 altogether. He did not know whether Captain Pim had considered the difficulty of docking loaded ships, but he feared the operation would be found to be rather dangerous.

The Chairman regretted there were not more gentlemen present inclined to discuss a subject of such vast importance. Mr. Saunders had referred to the insufficiency of the examinations as yet made of the isthmus; but he thought there was some misapprehensions on the subject. Various attempts had been made to obtain surveys of the whole isthmus, and he had in his possession a very extensive and complete survey made by the United States Government several years ago, which he should be very happy to show Mr. Saunders, in which as many as seven different routes across the isthmus were proposed. The two selected were, he believed, the one at Tehuantepec and the Nicaragua Canal. Those were the two which the United States officers desired to see established. Mr. Saunders was quite correct in saying that before any Government undertook a work of this magnitude, it would be essentially necessary to have a complete survey of the whole continent, but those acquainted with such operations would know that the whole isthmus offered very great facilities for carrying on triangulation, and when that was effected, the subordinate surveys could easily be carried through, and the different triangles filled in to any extent which might be necessary for the purpose of judging of the propriety of any particular route. No doubt, if the Governments of the United States, France, and England, were brought to undertake the matter jointly, the survey would be completed in a short time. He would remind them that this was no new subject, for from the time that Central America was first opened by the Spaniards, the question of crossing the isthmus had always been before the conquerors of that New World. It was, therefore, high time, after the lapse of four centuries, that it should be brought to a conclusion. Captain Pim's name had been connected with these schemes to a great extent; he was known to be one of the greatest authorities on the question of the different routes; he had devoted himself for many years to the subject; and he (the Chairman) had no doubt that the question which had been raised, both in France and England, by Captain Pim and M. de Lesseps, would be successfully worked out before the end of the century. At any rate, he hoped that Captain Pim would live long enough to see the work which he had commenced so long ago brought to a satisfactory conclusion.

Captain Bedford Pim, in replying to the observations which had been made, first referred to the Suez Canal as mentioned by Mr. Walford. He said he went over the whole of the ground with the late Robert Stephenson, and read a paper upon it before the Geographical Society, before the first spadefull of sand was dug. He, with Mr. Stephenson and Lord Palmerston, set his face most firmly against the idea of the Suez Canal, and he had not seen the smallest reason to alter his opinion down to the present moment. He was very sorry that there was such a thing as the Suez Canal. If any gentlemen from Manchester, connected with cotton spinning, were present, they would agree with him, that instead of the cotton coming

to Manchester as it used formerly to do, it had been stopped on the shores of the Mediterranean, where splendid cotton factories had been thrown up, robbing us thereby of an immense amount of trade. Old England had always been his first consideration; he had been taught as a midshipman so to think, and he hoped he should take with him into his grave as an admiral— for he supposed he should attain that rank in due time—the same spirit of looking to England before everything. He was anxious, therefore, that England should not make the same mistake with regard to the Nicaraguan Canal as she did about the Suez. He quite agreed with his friend, the Chevalier O'Clery, that they should come to terms with the United States Government before having anything to do with the practical building of the canal; then they would find that they had a useful work, and a door which could not be slammed in their faces the moment they wanted to use it. Mr. Saunders spoke about the insufficiency of the surveys, and that was quite true, as regards Nicaragua, for he believed the section now exhibited was the only one in existence. Mr. Bailey had nothing to do with any section between the Atlantic and the lake, though he made sections from the lake to the Pacific. But, with regard to the other portions, the Americans had spent an immense deal of time and money on the work. Captain Strain's journeys across at Darien were something marvellous, and the same remark would apply to other portions, from Tehuantepec down to Darien. Many years ago, his old ship, the *Herald*, did a good deal of surveying work there (though he, personally, was not fortunate enough to take any part in it beyond coast work), and some of the officers, notably Lieut. Wood and Capt. Kellett, even penetrated some way into the interior. Mr. Buckley's questions were no doubt the most important, and he would endeavour to answer them. He (Capt. Pim) professed to be a surveyor, but not a civil engineer, and he was advised in this matter of the pontoons by his friend, Mr. Latimer Clark, who, he regretted, had been prevented by an important engagement from being present. He was sure, however, that Mr. Clark would be glad to give Mr. Buckley every information on the matter if he would call on him, and for himself, he could assure him that no matter how deeply a ship was loaded, she could be easily raised on to the pontoons by this system. The cost of the pontoons would be nearer £5,000 than £20,000 each, and Mr. Clark would be happy to afford every information as to the mode of lifting and transport. In regard to the soil, there was not such a thing as an atom of sand to be seen. He was not a geologist, but a more clayey, muddy soil he never went through in the world; they were often in mud up to their middles. The water courses through the section were very numerous; as could be seen by the section on the wall.

Mr. Buckley asked if they were constantly running?

Captain Pim said they ran very fast when he was there. The number of pontoons would of course depend on the number of ships passing through the canal, but he did not think that vessels so large as 4,000 tons would go there. He believed the ships likely to use the canal would be sailing vessels, not exceeding 2,000 tons burthen. According to Admiral Maury, there were little monsoons in Nicaragua to bring ships up at each end of the canal, so that sailing vessels would be attracted there. Still, there was no doubt that a ship of 4,000 tons deeply loaded could be raised on a pontoon and carried through the canal. The Chairman, in his remarks on the surveys, had, he thought, disposed of his friend Mr. Saunders in the most conclusive manner; and he had only to thank him for his kind wishes, and to say that he sincerely hoped he might live to see the canal put through. He had taken the deepest interest in the matter for 20 of the best years of his life, and he should like to see it completed. In answer to another question from a member, he said the pontoons would be towed by small paddle-wheel tugs.

Mr. Buckley asked if it would be possible to take a man-of-war through the canal?

Captain Pim said he was particularly anxious that no man-of-war should be allowed to go near the canal. If he had his way he would not allow a man-of-war to go within 30 or 40 miles of either end of the Suez Canal, and the same with this one. He wished it to be a highway of nations for commerce, and commerce only.

The Chairman then proposed a cordial vote of thanks to Captain Bedford Pim for his valuable paper, and for the public spirit he had shown in the matter.

Mr. Walford begged to second the motion. Captain Pim had been the pioneer in this matter, and although he had been the object of much abuse in connection with it, he had still the courage to come forward and proclaim his belief, and to help on, to the best of his ability, this great work in the interest of the commerce of the world.

The motion having been carried,

Captain Pim, in returning thanks, said that whenever the Society of Arts asked him to come and read a paper on any subject which he understood, it always afforded him great pleasure to do so.

MISCELLANEOUS.

NOTES ON COMMERCIAL PLANTS REFERRED TO IN THE REPORT ON KEW GARDENS FOR 1878.

The recently issued "Report on the Progress and Condition of the Royal Gardens at Kew during the year 1878" contains a large amount of information on medicinal plants, food plants, and commercial plants generally.

Cinchonas.—On this subject it is stated that in the early part of last year the cultivation of these important plants at Hakgalla, in Ceylon, suffered very severely from the unusually wet season.

On the introduction of Columbian barks into India, Sir J. Hooker writes:—"The bark of the trees, however, which were cut down by the planters on showing signs of bad health, sold in the London market at prices little, if anything, below those obtained for the finest unbroken strips, peeled from perfectly healthy trees." The Indian Government sent Mr. R. Cross to New Grenada, for the purpose of bringing to England, for eventual transmission to India, plants of the species of *Cinchona*, yielding the "Soft Columbian" and "Hard Carthagena" barks of commerce. He arrived in this country in March of last year with five wardian cases containing 400 plants of the former and 200 of the latter. The hard Carthagena included as many as six different kinds. Further information confirms the prospect of success in the cultivation of *Cinchona* in Jamaica. A parcel of bark of *Cinchona succirubra* from Jamaica, sold in London in September, fetched 2s. 10d. per lb., being a higher price than was reached by either East Indian or Ceylon bark sold at the same time.

Cork Oaks for the Punjab.—Of the cork oaks introduced into the Punjab from Kew, in 1875, 28 are reported to be alive at Palampur, and, for the most part, healthy, having grown to a height of about 18 inches. In other parts numbers of trees, varying in height from a few inches to about two feet, are thriving.

Fodder Plants.—A good deal of attention is given in the present report on the subject of new fodder plants.

On this subject the report says:—"The discovery of new and easily cultivated fodder plants, especially those adapted to hot countries, is a matter which now excites great attention in India and the Colonies. It is inevitable that this should be the case, as the primitive physical conditions of newly settled countries gradually give way before the changes brought about by their occupation for agricultural and other industrial purposes. Both in North and South Australia the conservation of the natural pasture is already attracting grave consideration. Where the mischief is gone too far and is irremediable, the vegetation which is gone must be replaced by some substitute foreign to the soil." Amongst the more important of the fodder plants which, during the past year, came under notice at Kew, were *Prangos pabularia* and prickly comfrey.

The most recent introduction as a fodder plant is that known as the Teosinté (*Euchlaena luxurians*), already referred to in this *Journal*. The seeds of this plant have been plentifully distributed from Kew, having been sent to the Bahamas and the West Indies generally, Cyprus, South and Tropical Africa, Australia, the United States, and other places.

The grass is essentially tropical in its habits. Mons. Thozet in Queensland found single seeds to give rise to as many as 32 stems, each 12 feet high. Dr. Schweinfurth is said to have harvested at Cairo as many as 12,000 seeds as the produce of three single grains, and Vice-Consul Calvert states that at the same place in July of last year "the plant, after having been mown down, grew one foot in four days."

The superintendent of the Botanic-gardens, Singapore, writing under date of October, 1878, says that he intends growing the *Euchlaena* largely, as it promises to turn out an excellent fodder plant for that country. Dr. Schomburgk, in his report on the Botanic-gardens, Adelaide, abstracts of which were given in the *Journal* for August 22nd, 1879, p. 876, speaks very highly of this grass on account of its power of flourishing in very dry situations.

From the United States the Commissioner of Agriculture reports the attempt to extract sugar from the stalks, "but though a fair proportion of syrup was obtained, crystallisation could not be induced, and the results were unsatisfactory."

India-rubber.—The subject of the introduction and acclimatisation of the various india-rubber yielding plants into India and the British Colonies, has been put before the readers of the *Journal* at different times as progress has been made. With regard to the *Heveas* and *Castilloas*, the Para and Central American rubber plants respectively, a good deal of information is given as to the progress of the plants. In May of last year, they were reported in Ceylon, both at Peradeniya and at Heneratgodde as doing remarkably well. The *Heveas* were nearly 12 feet high, and were already quite handsome trees. The *Castilloas* also had grown into broad spreading trees.

Plants of *Hevea*, *Castil'oa*, and of the Ceará rubber have been sent from the Botanic-gardens, Singapore, to Queensland, where they have arrived in good condition. The two former have also been introduced into Perak from Singapore.. The *Heveas* are said to have taken to that country immensely, the plants being, in February last, 12 to 14 feet high. The *Castilloa* had grown into a spreading tree, 10 feet high, with branches 5 feet long. With regard to their propagation, Mr. Murton, of the Botanic-gardens, Singapore, says that he has found that the half-ripened shoots with a shield of hard wood are best, but unless kept tolerably dry, are very apt to rot off.

Plants of the Para rubber (*Hevea*) have been sent to Dr. Kirk at Zanzibar, as well as to the Fiji Islands; in the latter case, it is stated, without success. They appear also to have failed at Assam, which failure is attributed to the comparatively low temperature. Large quantities of Ceará rubber plants have been sent during the year to Madras and Calcutta. The opinions of Dr. King, of the Botanic-gardens, Calcutta, is thus expressed:—"Ceará rubber is going to be a success here." From Ceylon large supplies of the plant have been distributed to Calcutta, Burmah, Madras, and Singapore. At the last-named place the plants seem unable to withstand the wet season.

With regard to the East Indian rubber tree (*Ficus elastica*), Mr. Mann says, in his report for 1876-77:—"The planting of caoutchouc trees has not, as yet, emerged altogether from the experimental stage, for although no doubt remains that the tree will grow most luxuriantly in the locality chosen, the different ways in which the young trees have been planted did not all succeed equally well." Mr. Mann found that the best cuttings do not transplant so well as seedlings, and that raising plants from seed is the method of propagation which must be chiefly depended on. The total area under cultivation at Charduar was 572 acres, 112 acres additional having been cleared for planting. Of the Fijian caoutchouc plants which have been referred to two genera of Apocynaceæ, it is considered not improbable that they will prove to belong to one species (*Alstonia plumosa*).

Two other species of *Alstonia* also yield caoutchouc. One of these is *A. scholaris* (see *Journal*, 1864, p. 30), which is widely distributed through the tropics of the old world. The other is *A. costulata*, a native of the Malayan archipelago, which is described by Maingay as "abounding in pure caoutchouc."

In a recent mission to British Guiana, by Mr. Prestoe, the Government Botanist at Trinidad, he discovered a species of *Hevea*, at the penal settlement on the Mazaruni river. Mr. Prestoe says, "From what I saw, I have no doubt that this tree exists in the forests of Guiana in unbounded plenty. Some of the leading colonists knew of the india-rubber being sometimes collected by the Indians, but I met with no one who had any notion of the tree producing it, the supposition being that it was produced by a species of large-leaved *Ficus*."

The subject of rubber-yielding plants is concluded by a reference to the Liberian kind, furnished by *Urostigma Vogelii*, and recently introduced by Mr. Thomas Christy, and also by a reference to other African and some Malayan kinds, much information concerning which has been received at Kew.

Liberian Coffee.—With regard to Liberian coffee, the more general cultivation of which over the surface of the globe has occupied a great deal of attention during the past three or four years, a good deal is said in this report. From Dominica, formerly a well known coffee-growing country, reports come of the success of the Liberian kind. Over and above the more robust habit of growth over the *Coffea Arabica*, the freedom in seeding, and the larger size of the seeds themselves, the plants have another advantage—that of the fruits remaining so long on the trees after ripening as to afford ample time to gather the entire crop with comparatively few hands. With the old *Coffea Arabica*, plantations in Dominica often suffered considerable loss in consequence of the ripe berries dropping to the ground, and rotting before they could be gathered. From Singapore, a report says that two of the plants sent there from Kew in 1877, when they were not two inches high, were setting fruit at the end of last year. An average tree on the first Liberian coffee estate opened at Kalutara, Ceylon, was found in November last to bear 1,500 berries, which was calculated to be at the rate of 150 bushels to the acre, equivalent to 8·3 cwt. of clean coffee. It is hoped that by means of this kind of coffee, vast tracts in Ceylon of abandoned, or semi-abandoned low lying land, will be redeemed for cultivation. The ravages of the coffee disease in Ceylon, caused by the rapid spread of a microscopic fungus (*Hemileia vastatrix*), has occupied a large amount of scientific attention lately, since the life history of the disease has been known, with a view to

its extermination. Mr. Morris, late assistant-director of the Royal Botanic-garden, Peradeniya, who has devoted much thought to this subject, writes:—"I have obtained very important results with a mixture of sulphur and coral-lime in the proportion of one to three. The action of the sulphur seems to be much quickened, and the cost reduced to almost a third. In addition to this, no special blower is required, for a coolie supplied with the mixture in a bag can powder the tree very effectually by hand, and the smallest quantity of the powder deposited on the under side of the leaves is sufficient to destroy the filaments very thoroughly. The planters can now treat the whole of their estates in a week or 10 days, and at a cost not exceeding 50s. per acre. I cannot hope to see anything more satisfactory than this. The coral-lime used, which must be unslaked, will prove a valuable dressing to the soil, and thus the leaf-disease specific, pure and simple, viz., the sulphur, will cost only 20s. to 25s. per acre.

Oil Palm for Labuan.—The introduction of the African oil palm (*Elæis guineensis*) into Labuan has been under consideration for some time. A supply of fresh seeds were received from the West Coast of Africa in 1877 and sent to Labuan, where they were planted on the island of Daat. The acting Governor reports that this experiment resulted in establishing 700 young trees. These have since been transplanted, and are now said to be in a most healthy condition.

Tomatoes, onions, tobacco, and cigars are amongst the new commodities that are being exported from the Bahamas in quantities, the export of the first-named article amounting, during 1878, to 20,000 crates.

Bamia Cotton.—With regard to Bamia cotton, about which so much was said, and more expected, some two or three years since, the distribution of the seed has resulted in varying success. Mr. Chapman reports from Alexandria:—"Here the Bamia plant is mostly a failure, requiring an immense amount of water, and growing too tall, as high as 15 feet." On the other hand, Acting-Consul Calvert reports from the same place at the end of last year:—"The Bamyah cotton, introduced in this country four years ago, the cultivation of which is yearly increasing, is giving satisfactory results to the grower and consumer, and has commanded this season exceptionally high values, having obtained in Liverpool the classification of extra fine Ashmuni, and the comparatively small quantity available this season has been eagerly sought after." It has been tried experimentally in various parts of India with varying success. The quality of the cotton has not appeared to be materially different from that of ordinary Egyptian.

Gutta Shea.—The solid oil or fat obtained from the seeds of *Butyrospermum parkii*, which is known in West Africa as Shea butter, has of late years been used for soap making, being imported only in comparatively small quantities, from 300 to 500 tons annually. In consequence of its adaptability for making only hard soaps, it is mostly used in combination with other oils. Messrs. Henderson, soap makers of Glasgow, in using the Shea butter for the purpose of their business, have produced a substance to which they have given the name of gutta-shea. "It is present in Shea butter to the amount of ·5 to ·75 per cent. It appears to resemble, in many respects, gutta-percha, but is more brittle. It is insoluble in alcohol, a mixture of alcohol and ether, acids, and alkalies. It is slightly soluble in pure ether and ordinary animal and vegetable oils and fats. From the extremely small proportion in which it is present in Shea butter, its extraction would not be profitable. And, regarded as a bye-product, it does not appear to be suitable for any purpose to which gutta-percha itself is applied. The Kew Museum possesses a specimen of a substance akin to the latter in its properties, which is yielded by the Shea butter tree. It is possible that the so-called Gutta-shea, which is present along with fatty matters in the seeds, may have some connection with this."

A new tanning material is announced in the pods of *Wagatea spicata*, a scrambling, thorny, leguminous shrub, native of the Concan. These pods have been found, on analysis, to contain 15 per cent. of tannic acid. Living seeds of this new commercial plant have been received at Kew and distributed to Demerara, Dominica, Jamaica, Trinidad, and other places.

Paper-making Materials.—In consequence of the very great importance of the adaptation of new materials for paper-making, a great deal of consideration is given in the Kew report to this subject, more especially with regard to bamboo. This branch of the paper question has been so freely discussed in the *Journal*, that it will be necessary only to point out a few of the more salient points referred to by Sir Joseph Hooker. Thus it is shown that should the bamboo ever become a recognised paper material some of the species of tropical America, besides those of other countries, would most likely be found equally useful with the species of *Bambusa* and *Dendrocalamus*, of the East Indies. Besides bamboo, many other vegetable fibres which have been recommended for paper-making are referred to in the report, but these have for the most part already received notice in former reports and likewise in the pages of the *Journal*.

Sugar-cane disease.—Unfortunately, the plants of sugar-cane, in the various countries where it is extensively cultivated, have of late years been considerably affected by disease due either to fungoid or insect attacks. It is stated, with regard to experiments with diseased canes in Queensland, that the following treatment which has been found efficacious in that country may also be found effectual in other colonies:—

"1. Clean the joints entirely from all trash as carefully as possible. 2. Immerse for twenty-four hours in water and carbolic acid at a temperature to bear the hand—1 lb. of acid to 50 gallons of water. 3. Make milk of lime—2 lbs. of lime to one gallon of water; immerse the plants in this for a few minutes. 4. Lift out and spread in the sun, turning over to dry for one day before planting."

Out of twenty-four different varieties of cane so treated, all but two came up sound and healthy, and these two were but slightly touched with the disease, a few spots only showing on the outer ends of the leaves, while the heart of the cane was quite green and healthy. The old stools or roots from which were taken the plants so treated, all came up diseased, some of them died out, so that there can be no doubt that the mixture had its effect.

Vegetable-ivory substitutes.—The true vegetable-ivory from the seeds of *Phytelephas macrocarpa* are said to be used in such enormous quantities in this country, that Birmingham alone consumes as much as a ton weight per day, and that the value of the imports into Britain amount to £100,000 a year, besides very large quantities used in France. These different kinds of seeds are mentioned as substitutes for the true vegetable ivory, but none of them appear likely to prove as efficient.

A good deal of consideration is given to the sources and production of myrrh and frankincense as well as to other commercial products of vegetable origin. The report is in short an epitome of all that has been done in the introduction and distribution of new vegetabe products during the year.

During the year ending June 30, 1879, thirty-two ships sailed with emigrants for New Zealand, under the Colonial Government regulations. They carried 8,747 persons, equal to 7,739½ statute adults, and the total passage-money amounted to £112,686. The nationalities of these emigrants were as follows:—English, 4,195; Irish, 3,023; Scotch, 1,464; French, 3; Germans, 19; Danes, 2; Swedes, 1; Norwegians, 12; Italians, 4; others, 24; total, 8,747.

NOTES ON BOOKS.

Sizing and Mildew in Cotton Goods. By George E. Davis, Charles Dreyfus, and Philip Holland. Manchester (Palmer and Howe), 1880.

The main object of the authors in producing this book has been a wish to disseminate a knowledge of the nature of mildew and discolorations on cotton goods among practical men. Particular attention is paid to the production of the fungi, and illustrations are given, in the preparation of which the authors have had the assistance of Mr. Worthington Smith, the mycologist. It was found necessary to propagate mildew on fabrics, in order to make satisfactory observations on the fungal developments on cotton goods. Attention is specially called to the fact that colours on cotton cloth, produced by emanation from coal and wood tar, are liable to be mistaken for stains arising from mildew. A chapter is devoted to the consideration of the various antiseptics, both organic and inorganic, and a paper read in 1850, before the Society of Arts, on the causes and prevention of mildew on paper and parchment, is referred to. The chief points of the "Manchester Goods Case" are fully discussed in order to show "the unsatisfactory mode of procedure in cases involving the use of scientific evidence," and with the hope that a reform in this particular may thereby be hastened.

Hints on Vision, and the use of Spectacles. By John J. Whately. Lichfield, 1879.

The author alludes, in this little book, to some of the chief defects of sight, and draws particular attention to the adamantine spectacles which he has lately invented, and for which he claims the merit that they can be equally adapted for long and for short sight.

OBITUARY.

Mr. John Hunt, head of the firm of Hunt and Roskell, who died at the end of November, was for many years a member of the Society of Arts and of other learned and scientific societies. He was born in the year 1811. His father was Mr. John Samuel Hunt, partner in the firm of Storr, Mortimer, and Hunt, the head of which—Mr. Paul Storr—had been originally manufacturing partner in the house of Rundell and Bridge. Mr. Hunt earnestly endeavoured, during a long business career, to raise the artistic standard in the silversmiths' trade. In 1847 he acquired the services of Antoine Vechte, who received medals for his designs at the Paris Exhibition of 1855, and at the London Exhibition of 1862. He was one of the jurors for the latter exhibition, and his firm guaranteed £2,000. He was also a juror at the Paris Exhibition of 1867. Although his failing health prevented Mr. Hunt from taking an active part in the more recent International Exhibitions, his firm continued to receive medals for their productions.

GENERAL NOTES.

Royal Institution.—The managers have awarded the Actonian Prize of £105 to G. S. Boulger, Esq., F.L.S. F.G.S., for an essay on "The Structure and Functions of the Retina in all Classes of Animals, viewed in relation with the Theory of Evolution." Professor Tyndall will commence his course of Christmas Lectures (adapted to an educated juvenile auditory) on Saturday, December 27th, at three o'clock.

German Mining Statistics.—The statistics of production in Germany for 1878 show favourably in comparison with those of the previous year, considering the depression of trade which affected Germany not less than other countries:—Pig iron, 1878, 2,124,444 metric tons; 1877, 1,956,579 metric tons. Zinc, 1878, 94,954 metric tons; 1877, 90,362 tons. Lead, 1878, 84,372 tons; 1877, 80,278 tons. Copper, 1878, 9,541 tons; 1877, 8,362 tons. Tin, 1878, 831 tons; 1877, 831 tons. Antimony, 1878, 1,245 tons; 1877, 930 tons. Coal, 1878, 39,429,308 tons; 1877, 30,423,774 tons. Lignite, 1878, 10,971,117 tons; 1877, 10,644,427 tons. Asphalt, 1878, 47,329 tons; 1877, 29,735 tons. During the financial year 1878-79, there were in operation the following mines and other connected works belonging to the Prussian Government:—Coal mines, 17; lignite mines, 9; ironstone or iron ore mines, 10; lead, silver, and other metallic mines, 5; salt works, 6; rock salt mines, 3; stone quarries, 9; iron smelting works, 6; lead, silver, and other smelting works, 5.

The Production of Cane Sugar.—Consul Bidwell draws attention, in a report on the trade and commerce of Puerto Rico, to the Waterford mode of obtaining sugar from the sugar-cane. He writes:—"I may quote the following passage from a letter lately written by a gentleman in Puerto Rico well entitled to express an opinion on the subject:—'No one but an intelligent practical sugar planter,' he says, 'can conceive the enormous waste in producing cane sugar. The plant itself is almost in its wild state, for little or nothing has been done towards improving its natural conditions, or augmenting the saccharine richness of its juice. Attention seems scarcely to have been at all bestowed upon this most important part of the subject. In the manufacture of sugar the incredible waste is beyond all parallel in any other kind of business. The process is opposed to the most elementary principles of science, to the plainest deductions of common sense; and it is, to use the words of Mr. Fryer, 'not only costly, but as bad as it ever entered the heart of man to conceive.' But, even under other circumstances, it is safe to calculate that little more than one-third of the sugar is obtained from the cane which it is quite possible to extract from it.'"

MEETINGS OF THE SOCIETY.

Cantor Lectures.

Monday evening, at Eight o'clock.

The First Course, on "The Chemistry of Bread and Bread-making," five lectures, by Dr. Charles Graham, F.C.S., F.I.C., Professor of Chemical Technology at University College, London.

Lecture V. (and last).—December 22.

Baking; changes produced by heat. Aërated breads; foreign breads; biscuits, &c. Digestion of bread a continuance of fermentation; conditions requisite. Conclusion.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 22nd...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Dr. Charles Graham, "The Chemistry of Bread and Bread-making." (Lecture V.)

London Institution, Finsbury-circus, E.C., 5 p.m. Lord Reay, "Social Democracy in Germany."

Tuesday, Dec. 23rd...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Annual General Meeting.

Friday, Dec. 26th...Quekett Microscopical Club, University College, W.C., 8 p.m.

Saturday, Dec. 27th...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Tyndall, "Air and Water." (Lecture I.)

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FRIDAY, DECEMBER 26, 1879.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

JUVENILE LECTURES.

The usual short course of lectures, adapted for a juvenile audience, will be given by Mr. W. H. PREECE, on "Recent Wonders of Sound" and "Recent Wonders of Light." The dates for the lectures will be Friday, the 2nd, and Friday, the 9th of January next. The lectures will commence at seven o'clock. As the number of seats is limited, admission will be by ticket only. The issue of tickets is now discontinued, the full limit of the accommodation having been reached.

The Secretary will be greatly obliged if any member who is unable to use his ticket, will be so good as to return it, for the use of some one of those whose applications were too late.

NATIONAL TRAINING SCHOOL FOR MUSIC.

In consequence of the numerous applications from the public for admission, the Committee of Management of the National Training School for Music have made arrangements to receive private pupils for periods of not less than one year, on the payment of fees. Such pupils will be required:—

1. To pass a test examination to the satisfaction of the principal or of the Board of Professors.

2. To furnish the authorities of the school with certificates of birth and health, and with testimonials from persons of good repute as to moral character.

3. To pay, in advance, to the bankers of the school, Messrs. Coutts & Co., Strand, the sum of £40 per annum.

4. To sign an agreement to observe all the rules of the school, and to work out the curriculum of studies appointed by the authorities of the school.

Applications and inquiries should be addressed to the Registrar, National Training School for Music, Kensington-gore, S.W.

PROTECTION OF SHIPS FROM LOSS BY FIRE AND FROM LOSS BY SINKING.

Intending competitors for the medals offered by the Society of Arts for the above objects, are reminded that models or drawings of structural arrangements and of appliances, must be sent in not later than the 1st of January, 1880, addressed to the Secretary, Society of Arts, John-street, Adelphi, London, W.C., and must in every case be accompanied by a short description.

Full particulars of the offer were printed in the *Journal* for September 5, and can also be obtained at the office of the Society.

The two objects to be dealt with are—

1. Protection of ships from sinking, after collision, after touching the ground, &c.

2. Protection of ships from fire.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF BREAD-MAKING.

By Professor Graham, D.Sc.

LECTURE I.—DELIVERED NOVEMBER 24, 1879.

Ladies and Gentlemen,—Some six years ago I had the honour of addressing an audience in this room, upon a subject closely allied to that which will engage our attention on this and each succeeding Monday evening before the great festival of the Christian year. I refer to the course delivered by me on the "Chemistry of Brewing." The Council of the Society of Arts has again honoured me by a request to give a Cantor course, on some application of science to the arts; and in selecting the Chemistry of Bread-making, I have been guided by a consideration of the vital necessity of food to the existence of man. As cereals are, of all the fruits of nature, the most important to man for their invaluable store of flesh-forming and heat-giving principles, the right method of preparing these for his use is one well worthy of the most attentive study. Although the cultivation of the cereals is beyond our present province, which is limited to the study of the phenomena of bread-making, I shall incidentally have to refer to the effect of climate—and more especially to the influence of the weather at the ripening and harvesting periods—on the character of the wheat garnered; and I shall show that unfavourable climatic conditions not only seriously affect the quantity, but also the quality of the grain.

It may be thought by some that there is little need for a scientific study of bread-making, since man has already attained a considerable degree of excellence in its manufacture. This is true, but much remains to be done ere all inferior productions shall have given way to the loaf of unsurpassable excellence, and it is chiefly to science that we must look for a rapid development. It is true that in London we can, if we search for it, obtain

bread of excellent quality, yet we all know there is much that is inferior throughout the country; nor can our average of wheaten bread equal the average wheaten bread of France and Germany. This is, doubtless, partly due to the more favourable climatic conditions of those countries; but inasmuch as we import the best qualities of wheat from some of the most favoured countries of the Old and New Worlds, the inferiority of our average bread cannot arise chiefly from our less favourable harvesting conditions, but rather from the less skill and knowledge possessed by many of our millers and bakers.

A fuller knowledge of the chemical phenomena of bread-making must not only be of great value to the baker, but also to the consumer of bread. In this respect we are all interested in the phenomena of fermentation; and later in this course I propose to direct your attention to the digestion of bread, which is a process of fermentation, and to the conditions requisite for its due fulfilment.

The historic aspect of our subject is lost in obscurity. Probably, soon after man learned to till the earth, and reap a rich cereal harvest from his toil, the grinding of corn, and its admixture with water and salt, and then its heating, would be resorted to. Thus unleavened bread is made, and the earliest attempt to prepare ground cereals for man's use has not ceased to be practised. The oat cake of Scotland, and her peas and barley bannocks, the Passover bread of the Jews, the damper of the Australian shepherd, the American corn bread, are existing examples of that method of bread-making. In many parts of Spain wheat flour is simply mixed with water and baked, not even salt being added. There, not only the most primitive of all methods of bread-making is still pursued, but even the separation of the grain from the straw is carried out, as in Biblical times, by the treading out of the corn in the fields by oxen; and although the bread is deficient in salt, it is rich enough in fine, gritty sand.

The next step, and the most important one in the history of bread-making, whereby leaven was employed to lighten the product, is also of considerable antiquity. It is probable the Chinese may have been the first to make leavened bread. Be this as it may, we know that the Egyptians, in the time of Moses, understood the art, and from them the Greeks acquired the secret, and through the Greeks the Romans spread the knowledge, wherever their all-conquering and colonising armies went. Leaven, although a great improvement on unfermented bread, acts slowly, and gives rise to so much of high-coloured products, that it has, to a great extent, been replaced by yeast. The introduction of this important factor in bread-making probably took place soon after the art of making beer had obtained some degree of success, because the evolution of gas in the leavening process must have suggested the trial of yeast, which also evolves gas in the conversion of saccharine matter into beer. I have, however, been unable to find any authentic statement of its introduction in place of leaven. The preparation of leaven is still practised, and thus we have the unleavened, the leavened, and the yeast-fermented breads of the present day. But it is chiefly yeast-fermented breads which will occupy our attention throughout the course, although, incidentally, the spontaneous ferments of the leaven process will be considered.

Before we proceed to study the phenomena of bread-making, it will be needful to consider the constituents of the chief cereals, and to compare them, not only amongst themselves, but also with the more important articles of food employed by man. In the following table you will find a statement of the component parts of these cereals, wheat, barley, oats, rye, maize, and rice :—

Average Composition of the Grain of Cereals.

	Old Wheat.	Barley.	Oats.	Rye.	Maize.	Rice.
Water	11·1	12·	14·2	14·3	11·5	10·8
Starch	62·3	52·7	56·1	54·9	54·8	78·8
Fat	1·2	2·6	4·6	2·0	4·7	0·1
Cellulose	8·3	11·5	1·0	6·4	14·9	0·2
Gum & Sugar	3·8	4·2	5·7	11·3	2·9	1·6
Albuminoids	10·9	13·2	16·0	8·8	8·9	7·2
Ash	1·6	2·8	2·2	1·8	1·6	0·9
Loss, &c	0·8	1·0	0·2	0·5	0·7	0·4
	100·00	100·00	100·00	100·00	100·00	100·00

Bearing some of these numbers in mind, if we take the following table prepared by Messrs. Lawes and Gilbert with reference to the articles of food most used by man, we find that the ratio of carbon to nitrogen, in the case of flour, is 38 to 1·7, in meat as 30 to 2, in potatoes as 11 to ·3. We therefore notice that in the case of these cereals we have a considerable quantity of flesh-forming albuminoid matters, more especially in the case of wheat. I shall have again to refer to the subject of diet at a later period of the course.

Average Composition of Articles of Food. (*Lawes and Gilbert*)

Foods.	Dry Substance.	Carbon.	Nitrogen.	Nitrogen to 100 Carbon.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Meat (fresh)	45·0	30·0	2·0	6·6
Bacon (dried)	85·0	61·0	1·4	2·3
Butter	85·0	68·0	0·0	..
Milk	10·0	5·4	0·5	9·3
Cheese	60·0	36·0	4·5	12·5
Flour, (wheaten)	85·0	38·0	1·72	4·5
Bread	64·0	28·5	1·29	4·5
Maize	87·0	40·0	1·75	4·4
Oatmeal	85·0	40·0	2·0	5·0
Rice	87·0	39·0	1·0	2·56
Potatoes	25·0	11·0	0·35	3·2
Vegetables (succulent)	15·0	6·0	0·2	3·3
Peas	85·0	39·0	3·65	9·4
Sugar	95·0	40·0	0·0	..

We may conveniently divide the constituents of the cereals into three great classes. In the first place, those constituents which, by being burnt up in the system, produce heat. They are the materials that we call carbo-hydrates: the starch, the gums, and the sugars; it is from the oxidation of these carbo-hydrates, and also from the fat in our food, that the greater portion of the force that man

exerts is derived. The next great division it will be convenient to take is the albuminoids, or flesh-forming elements of the cereals; and lastly, the ash, which, although not great in quantity, is still most important in its bearing on the physiological phenomena which go on in the cells of animal life, and also because it is from the mineral matter of the ash that the bone structure of man is built up. Now, the mineral matter of the ash of wheat has been the subject of very lengthened investigations by numerous chemists. The series which, perhaps, on the whole, are most complete and trustworthy, are those made by Messrs. Lawes and Gilbert, and those by Messrs. Way and Ogston.

Composition of Wheat Grain Ash.

	Lawes and Gilbert.	Way and Ogston.
Phosphoric acid	49·68	45·01
Phosphate of iron	2·36	0·82
Potash	29·35	31·44
Soda	1·12	2·71
Magnesia	10·70	12·36
Lime	3·40	3·52
Sulphuric acid	....	0·34
Carbonic acid	....	0·02
Chlorine	0·13	0·13
Silica, &c.....	2·47	3·67
	99·21	100·03

We find from the former chemists' statements that the ash of wheat contains, in 100 parts, 49 of phosphoric acid; Way and Ogston say 45, so that nearly one-half consists of phosphoric acid. There is also a small quantity of phosphate of iron, but the next important constituent concerned is potash. That amounts to about 30 per cent. Lawes and Gilbert state, as the average of nine analyses, that they have found it to be 29·35; whereas the average of 26 analyses of various samples of wheat, by Way and Ogston, gives 31·44 phosphoric acid. Thus phosphoric acid amounts to nearly one-half, and potash one-third of the whole of the ash. The next important constituent is magnesia, amounting, according to Lawes and Gilbert, to 10·7, and to Way and Ogston, to 12·3. Lime, soda, and a small quantity of silica make up the remainder of the 100 parts. Phosphoric acid, a small quantity of iron, potash, and magnesia, are the characteristic constituents of the ash of wheat.

I will now proceed to examine somewhat fully the chief chemical and physical properties of the organic constituents of cereals, beginning with starch. I have here a table that indicates in our chemical language the composition of what we term the carbo-hydrates.

Formulæ of Carbo-hydrates.

Starch and Dextrin .. } = $(C^{12} H^{20} O^{10})\ n^{12}$

Cane Sugar and Maltose .... } = $(C^{12} H^{22} O^{11})\ n^{12}$

Dextrose .. Lævulose .. } = $(C^{12} H^{24} O^{12})\ n^{12}$

We use that expression in order to indicate that hydrogen and oxygen are found in the carbo-hydrates, in precisely the same ratio as they occur in water. These two elements, hydrogen and oxygen, do not exist in starch or sugar as water, but they exist in the same proportion as they do in water, and that expression has been applied to all these bodies. In the case of starch and dextrin you will notice the formula given here $[C^{12} H^{20} O^{10}]$ has a small "n" added outside of it. The simplest formula which would represent our knowledge of the centesimal ratio of the carbon, hydrogen, and oxygen would be $C^6 H^{10} O^5$, but we shall hereafter see so small a formula is insufficient to explain a number of reactions we know of in reference to starch. The formula of starch must, therefore, be written $(C^6 H^{10} O^5)\,n$. I have thought the formula $(C^{12} H^{20} O^{10})\,n$—in which even the value of n is probably high—would best express to those not well conversant with chemical science the correlation of the various carbo-hydrates in the table.

The next subdivision of this important class of bodies embraces cane sugar and maltose, indeed I might also have included sugar of milk.

They are isomeric, that is to say, that they have precisely the same ratio of carbon, hydrogen, and oxygen in their molecular composition, but they differ from the previous sub-groups in having one of oxygen and two of hydrogen more in the formula given. The last subdivision of this group embraces the glucoses, the simplest formula expressing their molecular composition being $C^{12} H^{24} O^{12}$. Here also we notice an increase of two of hydrogen and one of oxygen over the cane sugar group, which differs from the starch group in the same manner.

It is the first on our list of the carbo-hydrates that I have now to direct your attention. Starch is found in various vegetable structures, and for much the same purpose as fat is stored up in animals, for the future use of the organism.

It is thus found in pith. The sago of commerce is obtained by cutting down the sago plant and rasping the pith, and from that extracting the starch. It also occurs in bulbs, in tubers, such as the potato, in rhizomes, and in roots; and it also occurs in seeds, either in what is called by the botanist the albumen of the seed, although it is not albumen from a chemical point of view, but it is called so because it is convenient to consider the stored-up starch in ordinary grain by that name. If you take the caryopsis of wheat, the small embryo will be found at the bottom, surrounded by a large mass of starchy matter. It contains not merely starch, but also albuminoid bodies, and this, in botany, is called the albumen of the seed, for the reason that in the case of an ordinary hen's egg, the white of the egg surrounding the embryo is called albumen, and in both cases the albumen serves for the future growth of the young embryo. Starch is also found very largely in the fleshy cotyledons of some seeds, as, for instance, the ordinary bean, horse-chestnut, or pea, where practically the whole mass is made up of the two thick fleshy leaves that constitute the two halves of the whole seed, the young embryo being at the bottom. We see, therefore, that in all structures that are intended for the future growth of the plant, or, as in the case of seeds, for the reproduction of the new plant, that we have stored-up starch.

Starch was known to the Greeks; they called it *amulon*, from α and μύλη, indicating that it was not the product of a mill; they did not obtain starch from grinding the corn, but by bruising wheat, and by the employment of water they obtained this fine flour; and, therefore, they called it flour made without a mill. This Greek word has given rise to the scientific word amylaceous, which is used to indicate bodies which contain starch. The method by which starch is obtained from wheat or potatoes is this:—Formerly, it was entirely by a process of fermentation; the corn was roughly ground or bruised, then steeped in water, and allowed to remain for several days until spontaneous fermentation was set up, and the product of this fermentation consisted, as usual, of carbonic acid gas, and its oxidised derivative, acetic acid. There was also lactic acid formed by the breaking up of the sugar. This, therefore, was a wasteful process. After the glutinous matter of the wheat had been sufficiently disintegrated and broken down, the whole mass was worked in a bag with water, and in that way the fine starch passed through the minute holes in the bag, and ultimately was subjected to repeated washings, in order to get rid of any trace of albuminous matter or glutinous principles that were left, and then it was dried. The process, however, was not only offensive from the putrefactive decay which went on, but it was also wasteful. In modern times, by much better mechanical rasping in the case of potatoes, grinding in the case of wheat and other materials employed, such as Indian corn, and rice, the principal amount of starch is obtained; but instead of allowing that to undergo fermentation, in order to decay or break up and get rid of the albuminous matter, caustic soda is employed to dissolve the albuminous matter. Caustic soda and caustic potash have the property of dissolving albuminous matters with great ease. You all know the soapy feel which the alkalies have when you rub them between your fingers, and you can very easily, by means of a solution of caustic alkali, dissolve out from an adulterated sample of wool the whole of the wool and leave only the cotton. It is in this way that the modern starch-maker gets rid of the small quantity of albuminous matter that may still remain in the starch after the grinding and washing process. This alkali dissolves away the albuminous matter, but has no action on the starch itself.

Now, starch, however obtained, consists of minute cells, and these cells differ in size and also in form, according to their origin. The cells obtained from potato are about $\frac{1}{150}$th of an inch in diameter; those of sago are about $\frac{1}{300}$th, the cells obtained from wheat are about $\frac{1}{500}$th of an inch in diameter, and there are many smaller than those of wheat. The cell of potato starch, however, is larger than most, indeed, I think it is only exceeded in size by the cell of the maranta, and *Tous les mois*, arrowroots. All the starches have characteristic appearances under the microscope, and it is on account of the difference of form and the difference in size that we are able to detect adulteration; thus, when ordinary potato starch is mixed with arrowroot, or when some cheaper starch is mixed with sago, we are readily able, by means of the microscope, to detect and quantify the adulteration.

Starch is insoluble in cold water. Mr. Lewis—who has kindly volunteered his valuable services as demonstrator in this course—is now performing an experiment which everyone in the room has seen, but which I wish to repeat, having shown that starch will not dissolve in cold water. He is now acting on the starch in such a way, by means of heat, as to cause the little cells to be ruptured, and we shall then have the starch material, called granulose, pass out of the ruptured bag or cell, thus giving a solution or emulsion of the starch.

If to a solution of this boiled starch we add a little iodine, we obtain a blue precipitate, a combination of the iodine and starch, the so-called iodide of starch. With bromine we get, not a blue, but a yellowish reaction. This reaction of bromine on starch is so inferior, and of such very slight value in chemical investigations, that we rarely employ it; but the iodine reaction is remarkably sensitive, and by means of it we are able to detect very minute quantities of starch in various infusions in which these small quantities may exist. If we take some soluble starch, and add to it the liquid, called after its inventor, Fehling's solution, which consists of sulphate of copper, or blue stone, to which Rochelle salt, or the double tartrate of potash and soda is added, and then rendered distinctly alkaline by excess of soda, many organic substances, when added to such a solution as this of Fehling's, have no action, even upon being heated; but in the case of some we shall find there is a distinct action. Now, soluble starch does not produce any apparent action to you. I shall presently show you, when we come to consider one of the sugars derived from soluble starch, that we have a distinct attack upon the oxide of copper, which, in this liquid, is associated with sulphuric acid, as sulphate of protoxide of copper. The oxide of copper is deprived of one half its oxygen, which goes to oxidise the sugar, and a red sub-oxide of copper is formed, which you will presently see.

When soluble starch is examined by means of light that has been previously polarised, a remarkable action takes place. Polarised light is light which has been so acted upon that, instead of the ray of light vibrating in all planes at right angles to the axis of the direction of the ray of light—as when it has been acted upon either by a plate of glass inclined at an angle of 35° 25′ to the incident ray, or by means of tourmaline or a Nichols prism, or in many other ways—it is compelled to vibrate in two directions only. The vibrations of light are not like those of a knot on a string. If I had a string fastened at the other end of the room, with a knot in it, and caused it to vibrate, the knot would only vibrate up and down in one plane, but with a ray of light the vibrations take place in every direction at right angles to the axis of the ray, so that a section of it would have the appearance of the spokes of a wheel. It is thus different from the vibration of a knot on a piece of string, or of a bladder, or of a boat floating on the ocean where there is a wave motion passing towards the shore. Now, an inclined plate of glass, a crystal of quartz, a Nichols' prism of calc-spar, have all of them, more or less, the power to convert these vibrations into two distinct sets. All these various wave motions are converted into one-half, which vibrates in one plane, and the other half vibrating in a

plane at right angles to it. If a ray of light strikes an ordinary sheet of glass at an angle of 35° 25″, half of it will pass through the glass, and half will be reflected, and both halves will be polarised. They will be compelled—no longer to vibrate in an indefinite number of planes, all being at right angles to the axis of direction of the ray—but to vibrate in two planes, the whole of one set vibrating in one plane, and all the rest in the other, both sets of vibrations being in planes at right angles to each other, and also at right angles to the direction of the ray of light. Perhaps as simple an illustration as any is to take a wheel of a carriage together with the axle. Let the axle represent the direction of the ray of light, and let the numerous spokes of the wheels represent the numerous planes of the vibrations of ordinary light. These planes are variously inclined to each other, but all are at right angles to the axle, *i.e.*, the direction of the ray of light, in the same manner as the plane of vibration of the knot in the string is at right angles to the direction of the wave track. Now, imagine that the numerous spokes of the wheel are replaced by a ⊕ of two bars at right angles to each other, and manifestly also to the axle. In precisely the same manner the numerous planes of vibration of ordinary light are converted into vibrations in two planes at right angles to each other, and of course, also at right angles to the direction of the ray of light. Now, if I have previously polarised our light, and I have by certain means got rid of one-half of the light which is vibrating in one plane, and only use the other portion vibrating in the plane at right angles to it, I then find that if that light is passing through a tube to my eye, that some liquids, *e.g.*, water, would have no action at all, and I should find no difference; but in the case of other liquids, I am obliged, in order to see the light required, to rotate the instrument either to the right, or to the left, in order to get the particular light which I had before. All these substances which so act on the plane of polarised light, and cause it to be rotated so that I must turn the instrument to the right in order to see the light, are called dextro-rotary bodies. The other substances which rotate the plane of polarised light to the left, are called lævo-rotary. The amount of rotation brought about by a solution of starch is no less than 216°. In fact, I am obliged to rotate the tube nearly two-thirds round, in order to get the tint which I saw before putting the solution of starch into the tube.

Another interesting matter that I wish to draw your attention to, is the action of soluble albuminoids upon starch. I have here an analysis that represents the chief class of albuminous bodies, such as white of egg, and bodies analogous to it.

There are, no doubt,, numerous bodies more or less resembling white of egg in general composition, some being soluble in water, others insoluble. There are considerable difficulties in arriving at the true molecular weight of such complex, uncrystalisable substances as the albuminoids, and, up to the present, we are unable to assign, with accuracy, any formula to these bodies. According to Lieberkühn, the albumen from white of egg has the following centesimal composition:—Carbon, 53·1; hydrogen, 7·1; nitrogen, 15·7; oxygen, 22·1; sulphur, 1·8, and from this he deduces the formula $C^{72}\ H^{112}\ N^{18}\ SO^{22}$—this, of course, is hypothetical, the probabilities are that the molecular constitution of many of the higher albuminoids is much more complex than is represented by Lieberkühn's hypothesis. Now, on comparing the centesimal composition of starch:—Carbon, 44·44; hydrogen, 6·17; oxygen, 49·39,=100,—we see that in the albuminoids the carbon and hydrogen amount to 60 per cent., in the carbo-hydrates of the starch type these amount to 50 per cent. The characteristic difference, however, is in the substitution of nitrogen for a part of the oxygen.

If we take any substance containing an albuminoid, and it will be convenient for our purpose to take an infusion of ordinary malt, we shall find that on the unbroken, unboiled, cells of starch, the infusion of malt will have very little action. The infusion of malt itself contains some sugars, and, unfortunately, it is not easy to obtain from a vegetable infusion, albuminoids without at the same time having sugar products formed, but at any rate you will be able to see a marked difference between the action which takes place when malt infusion is added to unboiled starch, and when it is added to a starch in which the cells have been previously burst and the granulose matter allowed to exude from the rupture. This is some starch to which malt infusion was added. You saw it was blue before adding Fehling's liquid, and it is blue now, after boiling. In other words, there is nothing that is reducing or taking away the oxygen from the oxide of copper. It still remains the ordinary protoxide. In this other tube, previous to the malt infusion being added, the solution of starch was boiled, that is to say, the starch cells were broken up by boiling, and here you see there is an action on the oxide of copper which must be perceptible at the other end of the room. That is a reaction by which some sugars decompose oxide of copper, robbing it of half its oxygen. This reaction only takes place near the boiling point, so that we are obliged to heat such solutions. You see now the production of a yellow colour, rapidly changing to red. [The experiment was here made.]

The reason I have shown you this experiment, is that I shall have occasion to refer hereafter, to a very interesting process by which the baker long ago found out, before scientific men were able to tell him anything about it, the importance of using the material called in the trade, "fruit." This is simply potatoes. They do not take unboiled potatoes, but they boil the potatoes thoroughly, so as to entirely destroy the cell wall, and to allow the whole of the matter to exude from the cells; then they add this preparation, together with a small quantity of flour, to the yeast, in order to prepare what they called "ferment." The object in doing so I shall hereafter explain to you, and it is a most ingenious and able application of empirical science to bread-making, by which as small an abstraction and degradation as possible of the albuminoid matters, and of the starch of the flour, is allowed to take place, and yet a sufficiently abundant disengagement of carbonic acid as is necessary to make a light porous bread is brought about.

Mr. Lewis will now take this infusion of starch and add to it a small quantity of dilute sulphuric acid—hydrochloric acid would do equally well—he will boil it for a short time, and you will

find the starch is converted into sugar. You will remember I showed you that Fehling's liquid is not affected by the simple solution of starch, but if we take the solution of starch and boil it for a short time with dilute sulphuric acid, or hydrochloric acid, we shall convert the starch into sugar bodies. I shall have occasion hereafter to direct your attention for some time to the nature of the various sugar bodies —maltose, dextrin, and so on—that are formed in such cases, as they arrive. I shall be able to show that the same action has taken place by making use again of this valuable re-agent of Fehling.

If starch be heated to the temperature of about 300° Fahr., more especially if there be a slight quantity of moisture in the starch, it is converted into a substance which is called British gum. We call it dextrin because it differs from the ordinary gum arabic in its action upon the plane of polarised light. Dextrin is called so because it rotates the plane of vibration of polarised light 209° to the right. Here is a specimen of it. Dextrin may be prepared from starch in a variety of ways. The most convenient is to mix the two parts of nitric acid, or aquafortis, with 300 of water and then apply that very weak acid liquid to 1,000 parts of starch. They are thoroughly incorporated and left to dry in the air or by other convenient means. When dry, the substance is heated to the temperature of 220° Fahr. A much lower temperature is sufficient when the acid has been previously employed than when merely dry starch is used. Another method of making dextrin from starch is to take starch, and boil it in a small quantity of water, then add to that, an infusion of malt. The malt converts the starch into a variety of products, but the first action is to convert the starch into maltose—which is a sugar I shall have to describe to you hereafter—and dextrin. So soon as the iodine liquid indicates that the starch has disappeared, or that the whole, or nearly the whole, of the starch has disappeared, it is then rapidly boiled, in order to prevent the ferment in the malt infusion carrying on the hydration of the starch any further, the object being to obtain the gum or dextrin, and not maltose sugar. I said that mere heat would convert starch into dextrin, but much more so if the heat be moist. The Vienna baker, and, imitating him, the Parisian baker, employs this ingenious reaction in the glazing of the beautiful rolls of Paris and Vienna. It is their practice, and it is adopted in London by a few of our bakers, to allow steam from a boiler to be injected into the oven just as the bread is about to be placed in it. This steam, coming in contact with the highly-heated walls of the oven becomes superheated; it is not wet steam, but perfectly dry steam. The bread is, however, wet on its surface, and placed in this atmosphere, and the action of the steam upon the surface of the roll is to cover it with a beautiful layer of British gum, just the same as you will find at the back of postage stamps, which is also made from starch.

Dextrin or British gum, when made by either of the processes I have described, possesses the following properties:—It is a gummy body, resembling in its viscosity the ordinary cherrytree-gum and gum Arabic. It is employed largely in calico printing as a thickener, for the purpose of printing on the cloth the necessary mordants and colours. Dextrin is soluble in cold water, and starch, you will remember, is not. A solution of dextrin is precipitated by alcohol—more or less. You see the clear liquid is rendered turbid by the addition of alcohol. Iodine gives with dextrin little or no action.

There are two or three modifications of dextrin —erythro dextrin, which gives a brown tint on the addition of iodine; the others, achromatic dextrins, give no colour reaction, and are, according to Brown and Heron, the most numerous. Dextrin has no action on the Fehling's liquid, that is to say, pure dextrin, but if you repeat the experiment upon ordinary commercial dextrin, you will find there is a little action. This is owing to the mode of preparation. In acting upon starch by means of acid—which I have already shown you is one of the methods for making dextrin from starch—a small quantity of sugar must be formed. On the other hand, if you use the malt infusion, it cannot form dextrin without also forming maltose sugar, and hence, therefore, we have sugar formed as well as dextrin. The chemist has means at his command of separating from the ordinary dextrin the sugar, and also the starch, so as to obtain nothing else but dextrin, and a sample of dextrin so obtained has no action upon Fehling's liquid any more than a solution of starch has.

Basic acetate of lead, added to a solution of dextrin, throws down a precipitate, and this is sometimes a convenient re-agent to employ when you wish to remove dextrin from the infusions containing it. The action of yeast upon dextrin is very slow, but it does ultimately convert it into maltose sugar, and, of course, after that, into alcohol.

The next members of our carbo-hydrate series are cane sugar and maltose. Although probably of different molecular structure, they have the same centesimal composition. I have here a sample of the small crystals called Finzel's crystals, after the sugar manufacturer of Bristol, who unfortunately has been ruined by the export bounty system of the French Government, and who no longer now manufactures this product. On the whole, it is the purest sample of cane sugar that we can find in the market. Cane sugar is obtained not only from the cane plant, but also from the beet, the date, and the maple tree; it may also be obtained from many other plants, but these are the principal sources. The process of manufacture is not very intricate. It consists in the case of the cane of pressing the juice out, and then as rapidly as possible boiling it with a small quantity of lime, in order, first of all, to precipitate the albuminous matter, and so to neutralise the acid, because we shall see presently acids rapidly convert cane sugar, which is a crystallisable body, into the sugars which do not crystallise, which chemists call inverted sugars, or changed sugars, such as ordinary molasses consists of, and the solution of course is finally treated with animal charcoal in order to decolorise it. This latter part of the process is carried out in the refineries of England.

Cane sugar, when obtained in the pure state, you all know perfectly well, but there are some two or three reactions which I think will be of some in-

terest to you. I said a little while ago that in these carbo-hydrates the hydrogen and oxygen are in the proportion to form water, and by the employment of a little oil of vitriol, which is a substance that has a great affinity for water, it actually breaks up the molecule of sugar, and in so doing unite the oxygens and hydrogen, and forms water. That, of course, can only take place by the separation of charcoal. Mr. Lewis will add this material, which has such a power of absorbing water to the solution of cane sugar, and you will soon see the separation of charcoal. It is already black. Presently it will intumesce, and, you now see, so rapid is the action, an abundant separation of charcoal, the hydrogen and oxygen having been converted into water and absorbed by the acid. This is the action of strong acid. If, instead of acting on the sugar by means of strong acid I had used strong potash, we should find very little change. Fehling's liquid, added to a solution of cane sugar, provided the solution has been recently made, has no action, or a very slight action. The action is only due to the effect of the alkali itself upon the cane sugar. While I am heating this, Mr. Lewis will take a solution of cane sugar, and add to it a very few drops of sulphuric acid. We are not now going to convert it into charcoal, but into other kinds of sugar. You will see that this cane sugar, which has not been treated by acid, has no action on Fehling's liquid. It does not reduce the protoxide of copper to the sub-oxide, yet boiling it with acid, even for a short time—and manifestly it would be much better to boil it for an hour—is quite sufficient to change the cane sugar to fruit sugar, or inverted sugar. Having neutralised the acid by a little alkali, and heated it again with Fehling's solution, you see there is an abundant reduction from the protoxide of copper to the red sub-oxide.

This action is brought, about not only by mineral acids, but by all kinds of albuminoid bodies. Mr. Lewis will take a solution of cane sugar, and act upon it with a little malt infusion; this has the property of converting the cane sugar, to some extent, into the same products as result from the action of acids. That is the reason the West Indian planter is obliged, so soon as he has expressed the juice from the cane, to boil it as quickly as possible; were he not to do so, the acids of the juice, and the albuminoid matters, would rapidly convert the crystalline sugar into sugars that do not crystallise. These inverted sugars do not crystallise, at all, and the origin of molasses in the manufacture of sugar is because in spite of all his care—formerly, indeed, in the West Indies, very little care was taken—but in spite of even the care now taken there is always some crystallisable cane sugar converted into non-crystallisable sugars, and they come into the market in the form of molasses. Of course the larger portion of the molasses is converted into rum by fermentation and distillation. We are performing the same operation here, not by the use of the natural albuminoid bodies that exist in the plant, but by the aid of malt solution, and we have, even in so short a time, a partial conversion of the sugar solution.

The next matter to which I desire to draw your attention is that alcohol does not precipitate cane sugar, in other words, cane sugar is soluble in alcohol. Maltose sugar is precipitated by alcohol, which is able to dissolve a very small quantity of maltose, and one is obliged to take a very large quantity of alcohol in order to dissolve the crystalline substance called maltose.

The maltose sugar to which I now pass was first discovered by Dubrunfaut, but it was forgotten until O'Sullivan, of Burton-on-Trent, again studied the action of albuminoid ferments, such as we find in malt, upon starch. This table represents the action:

Hydration Products of Starch. (*O'Sullivan.*)

	Starch.			Maltose.		α Dextrin.
(1.)	$C^{72}\ H^{120}\ O^{60}$	+	$H^2\ O$	=	$C^{12}\ H^{22}\ O^{11}$	+ $C^{60}\ H^{100}\ O^{50}$
						β Dextrin, i.
(2.)	$C^{72}\ H^{120}\ O^{60}$	+	$2\ H^2\ O$	=	$2\ C^{12}\ H^{22}\ O^{11}$	+ $C^{48}\ H^{80}\ O^{40}$
						β Dextrin, ii.
(3.)	$C^{72}\ H^{120}\ O^{60}$	+	$3\ H^2\ O$	=	$3\ C^{12}\ H^{22}\ O^{11}$	+ $C^{36}\ H^{60}\ O^{30}$
						β Dextrin, iii.
(4.)	$C^{72}\ H^{120}\ O^{60}$	+	$4\ H^2\ O$	=	$4\ C^{12}\ H^{22}\ O^{11}$	+ $C^{24}\ H^{40}\ O^{20}$

In other words, the first action is to add one molecule of water. That is brought about by the agency of albuminoid ferments. The same action is brought about also by the saliva of man, because that also contains an albuminoid ferment called *ptyaline*. In malt, we have a similar albuminoid ferment, which has been called diastose. When one molecule of water is added, it causes a lesion of the complex starch molecule into the distinct products, maltose sugar $C^{12}\ H^{22}\ O^{11}$ (the isomer of cane sugar and five molecules of dextrin $C^{12}\ H^{20}\ O^{10}$). The next stage is to add two molecules of water. Then a further lesion is brought about by the ferment. In the last stage we have four molecules added, and thus we obtain four molecules of maltose sugar, and two of dextrin.

At our next meeting, I shall point out that Brown and Heron, in some recent researches, and also Grüber and Musculus, give some other hydration products in addition to those that are represented by O'Sullivan. Maltose sugar differs from cane sugar in the following respects:—The formula is the same, that is, the composition of 100 parts is the same, and the molecular weight is, perhaps, the same, but the properties that distinguish maltose are the following. Cane sugar only rotates the plane of polarised light 73° to the right, whereas maltose rotates the ray 150° to the right. It is much more dextro-rotary than cane sugar, although less so than starch. We saw that Fehling's liquid had no action on cane sugar, except, however, after a time, when the alkali began to break up the sugar. It has no immediate action, but we shall find on maltose

sugar Fehling's liquid produces an abundant and immediate reaction on boiling, still the amount of reduction of the protoxide of copper to suboxide is not so great as in the case of the next sugars we shall have to speak of, namely, the dextrose and lævulose sugars. 100 parts of maltose sugar only produces as much action on Fehling's liquid as 61 parts of dextrose or lævulose sugars. Therefore, although maltose has the same formula as cane sugar there is a distinct difference, first in the action on polarised light, and, secondly, in the action of Fehling's liquid. There is yet another difference; it is but slightly soluble in alcohol, therefore, the addition of alcohol to solutions of maltose will generally give a precipitate.

Maltose sugar is now being prepared somewhat largely in commerce, and here are some examples of it. One is the substance called O'Sullivan's dextrin maltose. It contains not merely maltose, but also dextrin. Here is another sample which is richer in maltose sugar and less rich in dextrin and has a lighter colour. The other important sugars, namely dextrose and lævulose, I propose to discuss at our next meeting, and will then call your attention to some later researches upon the hydration products of starch.

The fifth and concluding lecture of this course, on "The Chemistry of Bread-making," was delivered by Professor Graham, on Monday, December 22nd.

THE LIBRARY.

The following works have been presented to the Library:—

Science for All, edited by Robert Brown, M.A., Ph.D. Vol. 2. (London: Cassell, Petter, Galpin and Co.) Presented by the Publishers.

The Magazine of Art. Illustrated. (London: Cassell, Petter, Galpin and Co.) Presented by the Publishers.

Sizing and Mildew in Cotton Goods, by George E. Davis, Charles Dreyfus, Ph.D., and Philip Holland. (Manchester: Palmer and Howe; London: Simpkins and Marshall, 1880.) Presented by the Authors.

The following Science Primers, edited by Professors Huxley, Roscoe, and Balfour Stewart, have been presented by the Publishers, MacMillan and Co.:—

Chemistry, by H. E. Roscoe, F.R.S. (London: 1878.)

Physics, by Balfour Stewart, F.R.S. (London: 1878.)

Physical Geography, by A. Geikie, F.R.S. (London: 1879.)

Geology, by A. Geikie, F.R.S. (London: 1878.)

Physiology, by Michael Foster, M.D., F.R.S. (London: 1879.)

Astronomy, by J. Norman Lockyer, F.R.S. (London: 1879.)

Botany, by Sir J. D. Hooker, K.C.S.I., C.B. (London: 1879.)

Logic, by Stanley Jevons, F.R.S. (London: 1878.)

Political Economy, by Stanley Jevons. London: 1878.)

Messrs. MacMillan have also presented the following:—

First Principles of Agriculture, by Henry Tanner. (London: 1878.)

The School Cookery Book, by C. E. Guthrie Wright. (London: 1879.)

MEETINGS OF THE SOCIETY.

Juvenile Lectures.

The first of these Lectures, by Mr. W. H. Preece, will be delivered on Friday, January 2, at 7 p.m., on "Recent Wonders of Sound." The second lecture, on "Recent Wonders of Light," will be delivered on Friday, January 9.

Ordinary Meetings.

The first meeting after Christmas will be held on Wednesday, January 14th.

Section of Applied Chemistry and Physics.

The meetings of this Section will take place on the following Thursday Evenings, at eight o'clock:—

January 22; February 12; March 11; April 8, 22; May 13.

Indian Section.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock:—

January 30; February 20; March 5; April 2, 16; May 7.

Foreign and Colonial Section.

The meetings of this Section will take place on the following Tuesday Evenings, at eight o'clock:—

February 3, 24; March 16; April 6, 27; May 18.

A list of the papers to be read at the ordinary meetings and at the meetings of Sections will be printed in next week's *Journal*.

Cantor Lectures.

The Second Course of Cantor Lectures will be on the "Manufacture of India-rubber and Gutta-percha," by Thomas Bolas, F.C.S. It will consist of six lectures, to be given on the following dates:—

February 2, 9, 16, 23; March 1, 8.

A syllabus of this course will be printed in next week's *Journal*.

The Third Course will be by Mr. R. W. Edis, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—

April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 29th Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Mr. T. B. Sprague, "The Probability that there will hereafter be Issue of a Marriage hitherto Childless."

London Institution, Finsbury-circus, E.C., 8 p.m. Mr. W. R. S. Ralston, "Story-telling."

Tuesday, Dec. 30th...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Tyndall, "Water and Air." (Lecture II.)

Thursday, Jan. 1st....London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Morley, "The Future of the English Stage."

South London Photographic (at the House of the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Tyndall, "Water and Air." (Lecture III.)

Friday, Jan. 2nd...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Juvenile Lecture.) Mr. W. H. Preece "Recent Wonders of Sound."

Saturday, Jan. 3rd....Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Prof. Tyndall, "Water and Air." (Lecture IV.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,415. VOL. XXVIII.

FRIDAY, JANUARY 2, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

JUVENILE LECTURES.

The first of these lectures by Mr. W. H. Preece, on "Recent Wonders in Sound," will be delivered this evening, at 7 o'clock. A report of the lecture will be printed in the *Journal* in due course.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF BREAD-MAKING.

By Professor Graham, D.Sc.

LECTURE II.—DELIVERED DECEMBER 1, 1879.

To-night we pass on to the the third sub-group, the glucoses, having the formula C^{12} H^{24} O^{12}. These are dextro-glucose and lævo-glucose. Sometimes they are called dextrose and lævulose. They occur in fruits, and probably are due to the action of acids, or soluble albuminoid ferments, or both together, on cane sugar which has been previously stored up in the vegetable organism.

Dextro-glucose, the first member on our list, has been very rarely found in fruits unassociated with lævo-glucose. A very well known example of this glucose is to be found in ordinary honey. Honey consists of dextro-glucose and lævo-glucose, and also cane sugar. Dubrunfaut, a good many years ago, pointed out that the ratio of the dextro-glucose and lævo-glucose in honey was not that which would have occurred had the product been formed only and solely from the inversion, or change, of cane sugar previously stored up. In other words, instead of being found there in equal quantities, as much of dextro-glucose as of lævo-glucose, he found there was always an excess of dextro-glucose, which would indicate that some of the dextrose was due to the action of some ferment, not upon cane sugar, but upon some such material as soluble starch.

As regards the preparation of dextro-glucose from honey, one of the simplest processes is to take granulated honey, and triturate it in a mortar with one-eighth of its own weight of alcohol. The alcohol will dissolve out the lævo-glucose because it is more soluble; and if this be repeated once or twice, that which is not dissolved in the alcohol will consist of the dextro-glucose and a small quantity of cane sugar, or sucrose.

Another simple plan is to take the crystalline honey, and submit it to severe pressure through a calico filter. If it be pressed with considerable force, the lævo-glucose is forced out in the liquid form, and you obtain the dextro-glucose, together with the cane sugar, in the solid condition.

A much cheaper way to obtain dextrose than from honey is to convert ordinary starch into dextrose. This is done by acting upon a solution of starch with dilute mineral acid. Dextrose was first prepared in this way by the celebrated chemist, Kirchhoff. He took a solution of starch, and acted upon it with acid to the extent of 2 per cent. of the water that he employed, and after keeping it at a temperature of from 80° to 90° centigrade for four or five hours, he obtained the formation of this dextrose. If this acid solution be neutralised with some powdered chalk, the sulphuric acid —for it is better to use sulphuric than hydrochloric —is converted into sulphate of lime, or gypsum, and on filtering you obtain a solution of the dextrose.

This dextrose is now made on a large scale. This bottle contains dextrose. This which you see here has also been made from starch, and is known commercially as glucose. I am indebted for these two specimens of dextro-glucose to the kindness of the managing director of the Manbré Saccharine Company. The way in which it is prepared generally—I do not know exactly how this sample was prepared—is to take Indian corn, which is now largely employed for that purpose by American manufacturers, or rice (which probably is the material that the Manbré Saccharine Company employ), or to take some other starch-yielding material. The rice or the Indian corn is first of all broken into a tolerably fine condition, and then is mashed with water, that is to say, it is digested or infused with water to which one per cent. of oil of vitriol has been added. This is heated up by means of steam, and, after some few hours, it is pumped into a boiler or digesting vessel, in which it is heated by means of steam coming direct from a boiler at 70 lbs. pressure. In a short time, the steam being injected from the boiler at that pressure into this other digesting vessel, the temperature rises, and ultimately the tension or pressure in the digester is the same as in the generating boiler, and a comparatively short time is sufficient to convert the starch into dextrose. Whereas, doing it as I am here, at the atmospheric pressure of 15 lbs. to the square inch, a much longer time is required for the purpose. So soon as the operation is complete, and the operators are able to tell that from an experiment I showed you at our last meeting —you remember that alcohol precipitates solutions containing dextrin; you also remember that alcohols precipitate solutions containing maltose sugar — then, at the particular moment when alcohol fails to precipitate either the dextrin or maltose sugar, they know that they have nothing left but dextrose, because in this process, which goes on with acids, as I shall presently show you,

the bodies first formed are maltose and dextrin; but ultimately the maltose is hydrated to dextrin, and the whole of the dextrin is also hydrated to dextrose; so that, so soon as alcohol fails to give a precipitate, they know that the hydration process is complete. They then run it off into large tanks; powdered chalk is added to it, in order to neutralise the sulphuric acid; the whole is allowed to settle, and the clear liquid is drawn off, and passed two or three times through animal charcoal, in order to decolorise it. The amount of decolorisation, to some extent, depends on the price that is to be charged for it, and the object for which it is to be employed. Ultimately, it is evaporated down in vacuum pans; that is to say, the evaporation takes place not at 15 lbs. pressure, but (by means of a steam-engine constantly pumping away the steam from the evaporating vessel), at a pressure of only some two or three pounds. It comes into the market in this solid form. The letter I received this morning from the manager of the Manbré Saccharine Company, explained to me that it was quite easy for him to supply me with samples perfectly white. These are tinted. They have not been made at all for the purpose to which I propose to draw your attention in our next lecture. This sample was made to be used in the brewing of pale ale, but I wish to have some still whiter, because, as I shall have to point out, I propose that this dextrose shall be employed instead of potato, especially when inferior wheats are being used in the manufacture of bread.

Now, as regards the properties of this dextrose. In the first place, as the name implies, it is dextrorotary. It turns the plane of vibration of polarised light to the right hand 56°. It is less soluble in water, and also in alcohol, than cane sugar, and it is only half as sweet. If you try a portion from this bottle, you will find that it is not so sweet as cane sugar; indeed, it would take rather more than two parts of dextrose to produce the same sweetening effect as ordinary cane sugar. When oil of vitriol was added to a solution of cane sugar, you will remember that the cane sugar was broken up and charcoal was formed. You will find that the dextrose is more stable than the cane sugar, and that oil of vitriol does not break it up with the formation of charcoal. Mr. Lewis will kindly add some oil of vitriol to the solution of dextrose, and we shall find that there is no separation of charcoal.

While that is being done, I will pass on to the consideration of the other member of the series—lævo-glucose. This may be prepared from honey, either by the treatment of alcohol which I have explained, or else, and much more conveniently, by the simple method of pressure. It can be produced still more cheaply from what manufacturers call inverted or changed sugar, that is to say, ordinary cane sugar inverted or changed in its properties.

If you take 100 parts by weight of inverted sugar and rub it with 60 parts of hydrated lime—ordinary quick lime hydrated with water, so as to obtain a fine dry powder—and 1,000 parts of water, at first you obtain a tolerably fluid mixture. Presently the lime reacts on the dextro-glucose and the lævo-glucose, which together constitute what is termed inverted sugar, and the whole mass solidifies. If, now, you take the solidified mass, and submit it to very great pressure, the dextrose combined with the lime—a dextro-glucosate of lime—is pressed out. It is fluid, whereas the lævo-glucosate of lime remains as a hard solid body. Now, if you take this lævo-glucosate of lime and digest it in water, and add oxalic acid to it, the oxalic acid throws down the lime, and you obtain the solution of the lævo-glucose. When prepared in this or any other way, it has the following properties. It is called lævo-glucose or lævulose, that is to say, it rotates the plane of polarised light to the left, 106°. When we want to indicate a right-handed rotation, we put a + before it, whereas — indicates a body which rotates the plane of polarised light to the left. This lævo-glucose is uncrystallisable; it is never solid; it will not solidify like the dextro-glucose, and it is as sweet as cane sugar. It is much more soluble, as I have already said, in alcohol, and also in water, than its congener, dextro-glucose.

So much for those two separately. I will now proceed to indicate the general chemical characteristics by which we can recognise glucose—not considering if it be dextro-glucose or lævo-glucose—but simply that it is a glucose.

In the first place, these glucoses reduce Fehling's solution. Mr. Lewis will take a small quantity of the dextro-glucose and add to it this Fehling's liquid, which, as I told you, consists of sulphate of copper mixed with the double tartrate of potash and soda, and rendered alkaline by caustic soda or caustic potash. When it is heated to a temperature of about 80° to 90° the protoxide of copper will be reduced, and you will see the red suboxide of copper. These glucoses, whether dextro- or lævo-glucose, have a peculiar action upon a solution of nitrate or chloride of cobalt. I ought to point out that cane sugar, when added to a solution of cobalt, has not the power of preventing the precipitation of the hydrated oxide upon the addition of an alkali, whereas, if we have a glucose present, then the oxide of cobalt is not precipitated from its solution by the addition of a little alkali.

On the left, we have a solution of cane sugar. The liquid you see is coloured by cobalt, and Mr. Lewis has added a little potash to it. On the right is glucose—I do not know whether he has given me dextro-glucose, but it is of no consequence. He has now added cobalt to this on my left hand, containing a solution of cane sugar, and next potash will be added to them, and you see there is a thick precipitate formed. If this solution of cobalt is added to the solution on the right, and then potash added, we shall not obtain any precipitate. That is one means of recognising whether cane sugar contains some glucose, but as a reaction it is by no means so delicate as that resulting from the use of Fehling's solution.

The glucoses have a very marked and powerful reducing action, and by reducing action we mean that they are able to take away oxygen from other bodies; for instance, if you take an ordinary salt that you know very well, lunar caustic, or silver nitrate, if a glucose be added to that, together with a little ammonia—or, perhaps, a more convenient and better way of performing the experiment is to add a little ammonia to the glucose solution, so as to obtain an ammoniacal solution of glucose—then add silver nitrate to that, and gently warm it, the

will be precipitated in the metallic state. When I say that, I do not mean that you will see the silver having the same appearance as in a shilling, for it will be a black powder. Occasionally it happens that it is precipitated on the sides of the glass, so as to give a mirror-like appearance to it. If that black powder were put under a powerful hammer, you could force the particles together, and then they would have all the appearance of ordinary metallic silver as known to you.

Glucose has the power of changing blue indigo into white indigo, and we call that a reducing action. It is not properly a reducing action, but the expression is due to the amount of knowledge we had many years ago, when we thought that white indigo contained less oxygen than blue. We now have another theory to explain it, but all I wish you to understand is, that this powerful reducing agent can change blue indigo into white indigo on being warmed with a little alkali. You see, on warming the tube, how rapid the action is.

If I take this reduced indigo—highly coloured at present because potash acts on the glucose at a high temperature, and converts it into various coloured products—and put it into water containing a little acid to neutralise the alkali, you see I obtain the blue indigo again. Glucose in an alkaline solution has the power of converting a liquid that is much employed by chemists for the detection of iron in solution. It is called the red prussiate of potash, and it converts this salt into red prussiate of potash. The red prussiate of potash is reduced to the yellow prussiate of potash, or the ferricyanide into the ferrocyanide. Ferricyanide was poured into this tube, together with ferric chloride, or tincture of steel, and there was no reaction. Now, upon the addition of glucose to the ferricyanide of potassium, it is converted into ferrocyanide. Now, ferrocyanide gives with tincture of steel a Prussian blue, whereas ferricyanide gives with tincture of steel no such Prussian blue. You see, from the foregoing experiments, then, that glucose is a powerful reducing agent.

Another experiment, which it is hardly necessary to show you, is that caustic potash or soda has no action, or very little, on cane sugar, whereas it rapidly converts the glucoses into coloured products. The yeast organism has a powerful action on solution of dextrose. It converts dextrose very rapidly into carbonic acid gas and alcohol. The same action takes place with lævo-glucose; but if you take a mixture of dextro-glucose and lævo-glucose, such as is made from inverted sugar, then you would find that the yeast organism uses much more dextro-glucose per unit of time than it does of the lævo-glucose. After some time you would, perhaps, find no dextro-glucose left, but there would still be some lævo-glucose left, which would give a certain fullness on the palate when you were drinking the ales for which it is employed.

This leads me to give you a short description of the method employed for the making of this inverted sugar. I have a sample of it here, which has been made in that way. The cane sugar is dissolved in water, and a small quantity of sulphuric acid is added to it, about 1 per cent. It is then heated, and in the course of an hour, or an hour and a-half, the whole of the cane sugar has been converted into a mixture of equal parts of dextro- and lævo-glucose. This is evaporated down, and is employed very largely in the manufacture of beer—not exclusively, the proportion, perhaps, being one-fourth, or, more usually, one-sixth, along with malt—and the chief reason why the brewers employ this inverted cane sugar is, that it contains no albuminous matters. Now, in certain samples of barley, especially in some seasons, such as the one which we have unfortunately passed through, there is a large quantity of soluble albuminous matters formed, on account of the bad maturation period, just when these soluble albuminoids should be converted into insoluble. Under these circumstances, either a material such as this dextro-glucose, or a material such as you see here, which is a mixture of dextro- and lævo-glucose, is employed in order to give a certain stability to beer which otherwise it might not have.

Now, the cane sugar has a dextro-rotary power of + 73·8°; lævo-glucose has has a lævo-rotary power of —106°, and dextro-glucose a right-handed rotary power of + 56°. If you then add those together, and divide by two, you will find that the mixture has a lævo-rotary power of $\frac{-106° + 56°}{2}$ which is equal to — 25°, the optical activity of inverted cane sugar.

I think I have now gone through the more important properties by which we may recognise starch, dextrin, sucrose, maltose, dextro-glucose, and lævo-glucose, and I have, therefore, done for the present with the description of the properties of these important carbo-hydrates.

I have been somewhat lengthy in my remarks on these carbo-hydrates, and I daresay there are some few here who are very well acquainted with the properties of those bodies, but of course, in lecturing to a public audience, one must consider the audience in general, not those who may happen to have studied chemistry for some considerable period, and are tolerably familiar with these things; but I am bound to deal with these matters in this way, because, if we take a general audience, we shall find there are many who have not had the opportunity of studying chemistry sufficiently long—or perhaps not even at all—to have acquired a knowledge of these bodies. Manifestly, when we come to consider what goes on in the important process of panification, and in the more important process of fermentation, we shall only be groping in the dark, if we have not previously laid a solid foundation of knowledge connected with the important properties of these bodies that have to enter into the composition of the bread.

I now revert to the consideration of the phenomena that occur when certain albuminoid ferments act upon starch paste. I pointed out, at our last meeting, the valuable researches of Mr. O'Sullivan, the chemist for Messrs. Bass and Co., of Burton-on-Trent. It is some few years since he pointed out (not that he was the first, because it was Dubranfaut who first clearly recognised and named it) a new sugar, to which he gave the name maltose and, even before O'Sullivan, Musculus gave an explanation of the hydration products brought about by the action of albuminoids on starch paste, silver nitrate will be decomposed, and the silver

which was not in accordance with the previous views on the subject.

Six or seven years ago, when I had the honour to address an audience here, I was aware of what had just been published, but it was too late to alter my tables and statements; nor was I prepared to adopt Mr. O'Sullivan's researches in their entirety, so that, even then, I spoke of glucose and dextrin as being the products of the action of albuminoid ferments upon starch and sugar. We now know, however, thanks to the researches of O'Sullivan, and to the later works of Musculus and Grüber, and also to those of Brown and Heron, corroborated by other chemists, that under no circumstances does malt infusion ever produce either dextro-glucose or lævo-glucose, but only maltose and dextrin, and, consequently, maltose and dextrin are the products of the action of that important ferment on a solution of starch.

These equations* represent, according to Mr. O'Sullivan, the nature of the reaction. At about 140° Fahrenheit the reaction consists in one molecule of water being added on to a molecule of starch. The molecule I have here made very much larger than I have represented it in a previous table, where it was C^{12}. Here I have multiplied that 12 by six, the value I have given to the n, and the molecule represented here is C^{72}. We have, then, one molecule of maltose formed, and this complex molecule of α dextrin. Under other circumstances, a lower heat, and a longer time, two molecules are added on, a similar lesion of the compound molecule takes place, by which two molecules of maltose sugar are formed and β dextrin No. 1. Under still more favourable conditions, four molecules of water are added to the complex molecule; a lesion takes place, by which four molecules of maltose sugar, and a less complex molecule of β dextrin No. 3 are formed. Lately, Messrs. Brown and Heron have communicated to the Chemical Society the result of very long researches on the action of malt infusion on starch paste; and they find that, at a temperature of 60 degrees Centigrade, the following set of phenomena occur. They agree with O'Sullivan in the main, but not altogether. In the first place, if you take the molecule of starch, as they have here taken it, to consist of ten times C^{12}, in other words, if you give to that unknown n the value of 10, what occurs, according to them, is this:—

Hydration Products of Soluble Starch. (*Brown and Heron.*)
[*a.*]

	j. 3·86	k. 3·86	Resulting Dextrin.
Soluble Starch.	216·0°	0	
(1) C^{12} H^{20} O^{10}	209·0°	6·4	Erythro Dextrin α
+ (2) C^{12} H^{20} O^{10}	202·2°	12·7	,, ,, β
+ (3) C^{12} H^{20} O^{10}	195·4°	18·9	Achroo-Dextrin α
+ (4) C^{12} H^{20} O^{10}	188·7°	25·2	,, β
— (5) C^{12} H^{20} O^{10}	182·1°	31·3	,, γ
— (6) C^{12} H^{20} O^{10}	175·6°	37·3	,, δ
(7) C^{12} H^{20} O^{10}	169·0°	43·3	,, ϵ
+ (8) C^{12} H^{20} O^{10}	162·6°	49·3	,, ζ
(9) C^{12} H^{20} O^{10}	156·3°	55·1	,, η
(10) C^{12} H^{20} O^{10} (Maltose.)	150·0°	61·0	,,

* See table on p. 91, *Journal*, December 26, 1879.

A solution of soluble starch, at first, when examined by a saccharometer, indicates a right-handed rotation of the plane of polarised light of 216 degrees, and the reducing power on Fehling's liquid is nothing. In the course of a few minutes they find that the mixture, when acted on by a solution of iodine, indicates a brown colour. Of course, so long as there is soluble starch, the reaction with iodine would have given a blue colour, but after a few minutes at that temperature, the solution indicates a brown colour, with a right-handed rotation of 209°, and 6·4 action on Fehling's solution. In the course of two or three minutes longer, there is still a brown reaction, indicating what has been termed by Grüber erythro-dextrin. After that, however, at the particular period, where the right-handed rotation is 195°, and the reduction of Fehling's solution 18·9, they find that there is no coloured product, but they obtain an achromatic dextrin. I will not go through the whole of this table, but the ultimate action, when carried out for a considerable length of time, is that no dextrin is left, and that the whole has been converted into maltose sugar, having a right-handed rotation of 150°, and a reducing power on Fehling's solution of 61 per cent.; that is to say, 100 parts by weight of maltose sugar only reduces Fehling's solution as much as 61 parts by weight of dextro-glucose or lævo-glucose. According to them, what occurs is this:—This very complex molecule, 10 C^{12} H^{20} O^{10} is hydrated, and a lesion occurs, by which the first C^{12} H^{22} O^{11} is cut off; that is, maltose sugar and the complex body which is left has nine times C^{12} in its molecule. The next hydration product is where another C^{12} is cut off. At the successive steps successive molecules are cut off, all these being separate molecules of maltose, till finally, when this hydration process has been prolonged for 16 to 18 hours, the whole of the dextrin has been converted into maltose sugar, and the action then upon polarised light is + 150°. The sign + on the table indicates that these different reactions, 2, 3, 4, and 8, having a corresponding action upon the ray of polarised light, and a corresponding reducing power on the sulphate of copper, have been well established. They think also that the reactions indicated by 5 and 6 have been fairly well established, but the lower two have not been so.

Now, you may say to me, what is the practical meaning of all this? What does it matter whether three or four molecules of dextrin are formed, or whether there are a great many. We shall see. The practical result, I take it, is this. You must remember that Brown and Heron, precisely like O'Sullivan, have acted on starch paste, which is the representative of the boiled potatoes of the bakers, with a very powerful hydrating agent, and Heron indicates that, even though he uses so powerful a hydrating agent as a malt infusion, there are a series of dextrins formed, and that, practically, the amount of maltose that is formed at a low temperature with a hydrating agent of weak power, as the albuminoids of wheat, manifestly must give us bodies very rich in dextrin, and particularly poor in maltose sugar. Possibly some of you may have forgotten, what I have already mentioned, that the yeast organism converts maltose into carbonic acid and alcohol, but

the yeast organism has a very slight action on dextrin. Dextrin is a very stable body. It is so stable, as regards the power of the yeast organism upon it, that the German brewer, for example, and even the English brewer who wishes to imitate him, does all he can to try and obtain, in his infusion before fermentation, as much dextrin as possible from the hydration products of the barley. Now the dextrin is of no use to the baker; on the contrary, the more dextrin the baker forms in the panification process, either by employing bad flour, as I shall have hereafter to point out, or a bad process of fermentation—the more dextrin he forms in a given unit of time—whether it be six hours or 12 hours, the worse colour his loaf will be, because when you put dextrin bodies in the presence of moisture into an oven, they are converted into highly-coloured products; and the object of the baker, therefore, must be to find out some method by which he will get as much maltose formed, and as little dextrin as possible.

Then, I think, the next point we have learned, not merely from these researches of Heron and O'Sullivan, but from all previous studies, is this—that yeast has a considerable action on flour paste, but that yeast has a still greater action on soluble starch. I shall have to refer to these matters again.

I pass now, then, to the consideration of the albuminoids. Their general composition is given in this table:—

Average Composition of Albuminoids.

Carbon	53·3
Hydrogen	7·1
Nitrogen	15·7
Oxygen	22·1
Sulphur	1·8
	100

Hypothetical formula, $C^{72}H^{112}N^{18}SO^{22}$.

If you consult various works on the subject, you will find some slight discrepancies from the numbers given here, but this will fairly indicate the general nature of the albuminoid bodies:—Carbon, 53·3; hydrogen, 7·1; nitrogen, 15·7; oxygen, 22·1; sulphur, 1·8. Now, these are the analytical results given by the chemist Lieberkühn, and he converts the centesimal ratios of these elements, and gives us this hypothetical formula, $C^{72}H^{112}N^{18}SO^{22}$. I say hypothetical, because if starch has hitherto been too difficult for us to elucidate clearly the exact composition of its molecule, I need hardly say that the albuminoids are even more difficult.

The albuminoids of wheat flour differ very much from those of the other starches. We have on the table, the composition of the various flours.

On looking at the table, in the next column, you will see that of albuminoids 10·9 is given to old wheat, 13 to barley, 16 to oats, 8 to rye, 8·9 to maize, 7·2 to rice. Oats and barley are very rich in albuminoids, and probably most of you have considered that wheat is pre-eminently rich in the protein bodies, as they were called by Mülder, and that the value of any given sample of wheat flour would depend entirely on the total quantity of albuminoids in the wheat. I think I shall be able to demonstrate to you that such analyses as are given in this table, where all the albuminoids are put together under one head, are utterly useless, and give us no idea whatever as to the value of a given sample of flour for the purpose of making bread. If you take good wheat flour, and knead it with water—you all know the experiment—you will gradually get rid of the starch, and the gluten will cohere in a sticky adhesive mass. Of course, if you wash it sufficiently long, you get rid of the whole of the starch, and what remains is called crude gluten. The crude gluten, when moistened with water, coheres—its particles join together with considerable force. Here is a sample, and you will notice the peculiar tenacity of the elastic tough mass. The value in bread-making of this peculiar property is no doubt manifest to all of you. If you have a body of such an elastic nature, it will entangle the carbonic acid produced by the action of the yeast on the starch, and the carbonic acid, being entangled in this way, will raise the whole mass. An abundance of these albuminoids is, therefore, necessary to good bread-making.

Average Composition of Cereals. (Flour.)

	Old Wheat.	Barley.	Oats.	Rye.	Maize.	Rice.
Water	11·1	12·0	14·2	14·3	11·5	10·8
Starch	62·3	52·7	56·1	54·9	54·8	78·8
Fat	1·2	2·6	4·6	2·0	4·7	0·1
Cellulose	8·3	11·5	1·0	6·4	14·9	0·2
Gum and sugar	3·8	4·2	5·7	11·3	2·9	1·6
Albuminoids	10·9	13·2	16·0	8·8	8·9	7·2
Ash	1·6	2·8	2·2	1·8	1·6	0·9
Loss, &c.	0·8	1·0	0·2	0·5	0.7	0·4
	100·0	100·0	100·0	100·0	100·0	100·0

Crude gluten consists of four-fifths of fibrin, and one-fifth of an albuminoid body called glutin, spelt with an "i," in order to indicate the difference between that and the whole mass, which is called gluten. These are left in the kneading process, and such a paste as you have just seen consists of the fibrin and glutin. On the other hand, in kneading flour and water, there passes into the solution, along with the starch, an albuminoid body, that has been called sometimes casein and sometimes legumin. Now, if we take this gluten, we shall find that, when it is freed from water, it has no taste, and in addition to having no taste it is translucent. These biscuits, buns or loaves, which you see before you, have been made with the gluten of flour, and I would like you to examine them after the lecture. I am indebted to Mr. Bonthron, of Regent-street, for the different samples I have on the table here. He prepares the flour in such a way, that he can separate all the starch on the one hand from the crude gluten on the other. In this bag on the table, there is the crude gluten containing very little starch. In this other bag there is pure starch, and in this third bag, the flour from which these two products are obtained.

This kind of bread is used for diabetic patients, when the object of the physician is to restrain, as much as possible, the use of starch in the food. Formerly, this diabetic bread came from Vienna. There is one sample, a pleasant soft bread, not intended to last a very long time, I suppose about

ten days or a fortnight; so that patients living in different parts of England can readily obtain this kind of bread; whereas this other sample, dry, glistening, porous biscuit, will keep an indefinite length of time, doubtless for many years. I said just now that gluten was tasteless. I see Mr. Bonthron has also supplied me with some little cakes, something like ginger-bread. They are flavoured a little with ginger, in order that for lunch one may not always be driven to eat this tasteless mass. Some of these are prepared with almonds, and others with various flavouring materials, so that the patients can have a little variety in their diet.

I ought to mention that one reason I have for bringing this before your notice is, that these particular kinds of glutinous bread are made at about one-fourth or one-sixth the price of what they are sold at when brought all the way from Vienna.

Crude gluten is, then, a dry, tasteless, translucent body, where free from water; and we have seen that the crude gluten may be conveniently divided into glutin and fibrin. Glutin is slightly soluble in cold water, and much more so in hot water. Glutin dissolves in spirits of wine. I say spirits of wine, because if you were to take this product of Mr. Bonthron's, and act upon it with absolute alcohol, it would fail to dissolve out the glutin; but if you use spirits of wine, it would dissolve out all the glutin in time. Having thoroughly digested this crude gluten in spirits of wine, we have nothing left but the fibrin, and this fibrin is manifestly, therefore, not soluble in alcohol. Although fibrin is insoluble in water and in alcohol, yet, if we were to take fibrin and mix it with water, and allow it to be acted on at the ordinary temperature for a little time, it would gradually undergo putrefactive decomposition, and ultimately produce offensive products, but long before that occurred, in undergoing putrefactive fermentation, the complex nature of the fibrin would be broken down, and some soluble albuminoids would be formed. This degrading action takes place when grain or flour has been damaged by water, and this kind of fermentation process occurs; and, instead of obtaining the powerful elastic gluten we have a material that has very little tenacity.

The soluble albuminoid bodies are the legumin and albumen. I prefer to call it legumin rather than casein, because legumin is found mainly in the seeds of the *leguminosæ*: beans, peas, tares, and such like seeds. It is soluble in water, and in alcohol; it is precipitated by acetic acid, but the aqueous solution of legumin is not precipitated on boiling.

The next member that is soluble in water is the albumin. Albumin is precipitated by alcohol, and also upon boiling a solution containing it. You all know that occurs also with ordinary animal albumen—that a solution of albumen, when heated, coagulates, as occurs when you boil an egg for some little time. One of the most delicate reactions to distinguish a small quantity of albumen, whether vegetable or animal, in solution, is to add to it some ferrocyanide of potassium and acetic acid. While Mr. Lewis is performing that experiment, I will pass on to the consideration of the last of the albuminoids to which I wish to draw your attention.

In the husk of wheat, that which one separates under the name of bran, occurs another albuminoid body called cerealin. Now cerealin has a very marked action upon starch, in other words, it acts as the so-called diastase. It acts like malt infusion, and the object of its being there, gathered together mainly in the bran, is for the purpose of enabling the young germinating plumule to obtain a large supply of nutriment not entirely from the starch, but to a great extent from the cellulose structure of the outward layers of the corn. The cerealin, like many of the albuminoids, is precipitated by alcohol and also by acids. Now these soluble bodies, legumin, albumin, and cerealin, one or more of them occur in all seeds, and the reason that they occur in seeds is that they thereby present, under the germinating process, precisely what all chemists use in the researches upon starch, a material that has the power to convert the starch, and even the cellulose, into soluble materials, because you will remember that starch and cellulose are insoluble in water, whereas when converted into various sugar bodies, they dissolve, and can be absorbed by the cells of the young growing plant. Now, the amount of this is somewhat increased by the process of sprouting or germination. I have here an analysis of the albuminous substances found in barley and malt.

Albuminous Substances.

	Barley.		Malt.
Glutin (soluble in alcohol)	0·28	....	0·34
Coagulable by heat	0·28	....	0·45
Non-coagulable.....	1·55	....	2·08
In soluble albumin	7·59	....	6·23
	9·70		9·10

In the case of barley, it is 9·7, and in malt 9·1, but there has been a considerable reduction in the amount of the insoluble albuminous bodies. They were 7·5 in barley, but they are only 6·2 in the case of malt, with, of course, a corresponding increase in the quantity of the soluble albuminoid bodies. Sprouting increases, first of all, the quantity of the soluble albuminoid bodies; but, while that is noticeable enough, it is by no means so remarkable as the peculiar change that has taken place. Ordinary soluble albuminoids, in a well germinated and well garnered barley or wheat corn, are not very active in their action upon starch, whereas if sprouting has taken place at all, in other words, if the germinating process has taken place, then there is a very marked increase of action.

I find time is passing so rapidly, that I must defer some matters to our next meeting, and I will just draw your attention to the character of the albuminoid bodies in the other cereals. Passing to barley flour, the chief difference in barley flour, as compared with wheat, is not in the amount of the albuminoid bodies, but in their character. If you take barley flour and knead it with water, as one often does, with flour, you would, after washing for some time, find that there was a very small quantity of this crude gluten left, and that barley flour would be a very inappropriate material to form a good loaf with. Of course, I know that barley flour has been used for ages, but if anyone present has been in the habit of eating barley bread, they will know to what I refer—it is a heavy, sticky, doughy sort of mass. It is more

like wheat treated by the boiling process than by the oven process.

Rye flour, very rich in the total quantity of albuminoids, is so deficient in crude gluten, that when you knead it with water there is practically nothing left, the whole of it passes away along with the starch; not that it is soluble, but it is not coherent, and therefore does not form that tough, elastic mass, which is so characteristic of wheat under the same conditions.

Precisely the same may be said of oat flour. I do not know whether anyone present has ever seen oat-flour fermented with yeast in the ordinary way; but it is a heavy mass, and practically the same may be said of maize. Now rye flour is very much used in the North of Europe for the purpose of making bread; and it is with rye flour chiefly that the leaven process is employed; and those who have travelled in the northern parts of Europe will remember perfectly well the dark kind of bread that rye, fermented by leaven, gives. To a great extent, the same remarks as to the want of cohering elastic gluten would apply to oats, or barley, or any other cereal than wheat. Wheat, then, is pre-eminently fitted for the purpose of making bread by the fermentation process, since it is so rich in this tough elastic gluten, which holds in the carbonic acid, and enables you to have a light, aërated bread.

MISCELLANEOUS.

TECHNICAL EDUCATION.

The paper which was read before the Society by Professor Silvanus Thompson, on the 5th of December, on the subject of Technical Education, has given rise to a good deal of discussion in the *Times*. This was commenced by a leading article on the 11th of December, commenting upon the remarks made by Professor Huxley, when presiding at the meeting on December 5th, with reference to the delay of the City Guilds in founding the Central Institution for Technical Education, which was proposed by them some two years ago. Professor Huxley replied to these comments in a letter (14th December) and stated definitely what his views were upon the action of the representatives of the City companies. Next, Professor Perry, who had also taken part in the discussion here, wrote (December 17th) drawing attention to the scheme of Technological Examinations, and this brought out a letter from Colonel Donnelly upon the same subject (24th December), in which he criticised somewhat severely the alterations made by the City Institute in the original examination programme of the Society of Arts. To this, Mr. Owen Roberts, one of the honorary secretaries of the City Institute, replied (26th December) defending the Institute's programme, and also took occasion to answer some of Professor Huxley's remarks. Professor Huxley again wrote, (on the 29th December), expressing gratification that the proposed Institution was likely to be founded, but disagreeing with Mr. Roberts upon some of the points which he had raised. This latter part of the correspondence in reference to the Technological Examinations afforded material for a second leading article on the 27th December, and on the same day the *Times* also published a communication which gave an account of the action of the City Institute since its foundation. From this it may be interesting to reproduce the following passage, which refers to the most important portion of the movement—the foundation of a Central Institution in London for providing instruction in the application of science and art to industry:—

"The original idea had been that the Institute should acquire a site on the Thames Embankment for the purposes of their building; and other suggestions had also been made, such as the acquisition of Gresham College, though these were not referred to in this report. It appeared, however, that the whole, or nearly the whole, of the property belonging to the Corporation on the Embankment was already bespoken for other purposes. Under these circumstances, the thoughts of the committee naturally tended to that focus of science and art, South Kensington. In a report then lately issued by the Commissioners of the 1851 Exhibition, to whom, as is well known, the plot of land belongs, comprising the Horticultural-gardens and the Albert-hall, it appeared that the Commissioners also had their notions of a Technical University, and that they had proposed to the Government to spend £100,000 of their available capital upon a suitable building for such a purpose, provided the Treasury would undertake its maintenance; but, though the Commissioners were ready to build, the Treasury was by no means inclined to maintain, and it was tolerably well known, although no official intimation had been given, that this project had fallen to the ground. The committee of the City Institute not unnaturally thought that their funds might supply the want which the Treasury were unable to supply, and in their report they suggested that an offer should be made to the Commissioners to erect and maintain a building, provided the Commissioners would provide the land. In this, it will be noticed, the committee went a little further than it had been suggested the Treasury should go, as it had been asked only to maintain a building which the Commissioners were ready to erect. When the suggestions contained in the report came before the Governors of the Institute, it became evident that anti-Kensington feelings were pretty strongly represented. The citizens of London were anxious that their University should be within the City; and they also felt and expressed a not unnatural dread that the well-known absorbent power of the Science and Art Department might be detrimentally exercised upon their funds. Still, after much discussion, the Institute consented to this part of the scheme. Accordingly, communications were entered into between the Institute and the Commissioners. These went on for some months, but the harmony with which they commenced does not seem to have been continued to the end. The fact appears to be that both parties distrusted one another; the City thought that its Institute would be merged in South Kensington, the Commissioners doubted the administrative powers of the Institute. Eventually it looked as if the two parties might come to terms. The Commissioners promised to give so much land as the Institute would cover with buildings—viz., half an acre—on condition that suitable buildings should be erected and maintained, that the buildings should be preserved for educational uses alone, and that they themselves should be represented on its governing body. This last proposal was, of all, the hardest to accept. The City felt that when they were subscribing their funds, it was hard that they should not be allowed the full control of them. A proposal that some of our chief scientific bodies should name representatives was even more distasteful. Eventually, however, the conditions, except this last mentioned one, were, somewhat grudgingly it seems, accepted, and it appeared likely that the whole arrangement might go smoothly on.

"Such, however, was the feeling of some members of the City committee that they began casting about for an alternative scheme. It occurred to them that the big house built at Kensington by Mr. Albert Grant for his own use, and at present lying idle and likely to remain idle, would be admirably adapted for their purposes. The idea was enthusiastically taken up, plans were prepared, estimates obtained, and some of the larger companies were even induced by their more earnest members to vote considerable sums in aid of the purchase; but when the proposal came before the committee the old feud broke out. Eagerly as its promoters supported the scheme, the anti-Kensingtonians threw themselves with no less ardour into opposition. So vigorously did they combat the notion that, although the matter is even now under consideration, it appears to have practically fallen through. There is, indeed, something to be said on both sides. Putting aside the question of price, which is a mere matter to be arranged by business heads in the City, the building itself is probable capable of such ready transformation as would suit it excellently well for a college. It may be fairly assumed that a college for teaching technical science does not differ very widely from a college for teaching anything else, except as regards such extra provision of laboratories and workshops as may be required for the special subjects taught. Kensington-house is full of big rooms which could readily be transformed into theatres, class-rooms, and laboratories. The grounds offer space for workshops for every kind of trade which the University could deal with for the next half-century. The situation, though not central, is sufficiently accessible; the building, though tastes may differ as to the purity of its style, is certainly of an imposing character. In fine, a Technical University so located might challenge comparison with any of the older foundations of similar character in Europe or America. On the other side, the situation would be in the centre of the fashionable quarter, not the business quarter, of London, and the amount of land available is very much less than could be obtained for the same cost—whatever the cost may be—in one of the outlying suburbs of London. There are but few artisans living within a reasonable distance of Kensington; there are no industries carried on in its neighbourhood, or nearer than the other side of the river. It is certain that these objections are lessened by the consideration that a central University would be intended for the whole country, and would have for its students the best men, attracted by exhibitions, from the whole of England; it would not be intended especially for the trades or for the artisans of London, and wherever it might be located it would attract its students to itself. On the whole, the proposal, if not free from objections, may be said to be as satisfactory a one as the Institute could have hoped for, and if their committee cannot agree upon such a scheme as this, it is hopeless to expect any scheme on which they can agree. If the City Companies cannot or will not provide a sufficient fund, the question, of course, falls to the ground; if they cannot, they are very much maligned; if they will not, they are blind to their own interests, inasmuch as it is tolerably certain that sooner or later, with their consent or without it, they will have to provide funds in one form or another for the education of our working classes. So, however, the question of the central University now rests; the proposal to erect a building on the land of the Commissioners of 1851 is in abeyance, it has neither been rejected nor accepted; the proposal to buy Kensington-house is being thought over, but the vigorous opposition with which it has been met seems to have quenched the ardour of those who brought it forward. Whether either of these schemes will be accepted, or whether some new one will not be brought forward to be discussed, if not to be acted upon, time only can tell."

POPULATION AND INDUSTRIES OF URUGUAY.

The Republic of Uruguay has an area of about 70,000 square miles, and it is divided into thirteen departments. The population is estimated at 440,000. The department of Monte Video is the most densely populated, having 110,000 inhabitants. The other twelve departments average 27,000 inhabitants each. The city of Monte Video has a population of 92,000 inhabitants. Of the 111,000 inhabitants of the deepartment of Monte Video, 66,000 are natives, and 45,000 foreigners. And with a view of showing the relatively good position enjoyed by foreigners as compared with the natives, Mr. Ford, secretary of the Legation, states that whilst only 44 to every 1,000 of the 60,000 native inhabitants in the department of Monte Video are holders of property, there are 122 to each 1,000 who hold property out of the 45,000 foreigners. Spaniards, to the number of 14,000 (mostly Basques), and Italians, to the number of 13,000, preponderate in the foreign population of the department. The number of English amounts to 1,300, but they are principally merchants, clerks, persons employed on the railways, &c. It is estimated that there are nearly 40,000 Brazilians settled along the northern skirts of the Republic bordering on their own country. The emigrants to Uruguay are chiefly persons belonging to the Latin races, whilst the contrary is the case to the United States of America. In Monte Video there are 63 schools, with 10,000 pupils.

Sheep and cattle, and the produce of them in the shape of wool and hides, form the main staple of the wealth of the Republic. Indeed, the estimated number of cattle in the country is nearly £20,000,000 head, valued at £10,000,000 sterling. England and France are the two countries that carry on most trade with the Republic. France and Belgium are Uraguay's best customers for wool; nevertheless, three-fourths of the import trade of the Republic is furnished by England, and consists of stuffs of different descriptions, cotton particularly, and other sorts of goods. It is a remarkable fact, that whereas, six years ago, the wheat grown in Uraguay was not sufficient for the home consumption, and corn had to be imported from Chili and the United States to meet the deficiency, now the quantity produced is not only enough, but cereals to a large amount are annually exported to Brazil, and for the first time last year to Chili, owing, no doubt, to a failure of the crop in that country. The value of cereals produced in Uraguay amounted in 1878 to more than £600,000, yet not more than 1 per cent. of the rich land of the country is in a state of cultivation.

One of the most important establishments in the Republic is the one situated at Fray Bentos, on the banks of the River Uraguay, where the famous "Liebig's Extract of Meat" is made. From 400 to 500 persons are employed there every year. The annual consumption of coal is 7,000 tons, and the value of the production of the establishment is estimated at nearly £550,000 sterling. As many as 800 head of cattle are killed during the season, in a single day. From 60 to 80 vessels are employed every year for exporting its produce to Europe, and the profits of the company are said to be as much as 20 per cent. The number of animals slaughtered in 1876 in the Republic was 625.457, and the value of the meat, which, when salted, is an article of general consumption amongst the negroes inhabiting the Brazils and Cuba, was estimated at £670,000. A new branch of trade, and one which is likely to prove of value, has sprung up in the traffic of a kind of artificial guano, which is fabricated from the refuse of slaughtered animals. In the year 1872, 372,045 tons of this article were exported, and in 1875 the trade had increased to 4,060,487 tons.

There are four railways, the most important one being

the Central Uruguay, which is now formed into an English limited company. It runs from the city of Monte Video to Durazus, a distance of 127½ miles. The Salto and Santa Rosa railway has about 56 miles completed, leaving about 50 still to be constructed. It is situated in the extreme north-western portion of the Republic, and is owned by an English company. If completed, this railway will be of great service as a vehicle for trade with Brazil, which is rendered difficult at present, by reason of an obstruction in the navigation in the River Uruguay, caused by rocks and rapids to the north of the town of Salto. The Pando railway, constructed by private enterprise, is in an unfinished state. It was intended to run this line from the city of Monte Video to Minas, on the south-eastern portion of the Republic. The Northern railway, 12 miles in length, is a small railway running to the bar of the River Santa Lucia, where the "abattoirs," or slaughter-houses are situated. The traffic on this line is mainly confined to the meat brought into the city of Monte Video.

The mineral wealth of the Republic is, as yet, almost wholly unexplored and undeveloped. In some parts very rich and handsome marbles are found. There are also mines of lead, copper, and manganese, and quartz with gold formation. A company has lately been formed in Paris for working the gold mines in the department of Tacuarembo, on the Brazilian frontier, and the machines for working were expected very shortly to arrive in the country.

ARTIFICIAL DIAMONDS.

Professor Nevil Story Maskelyne, F.R.S., of the British Museum, has examined the presumed "diamonds" manufactured by Mr. James Mactear, of St. Rollox, Glasgow, and has published the result of his examination in a letter to the *Times*, from which the following is extracted:—

"Firstly, the diamond excels all substances in hardness. Secondly, its crystals belong to the cubic system, and should not, therefore, present the property of doubly refracting light. Frequently, however, from the influence of strain within the crystal, caused by enclosed gas-bubbles or other causes, diamonds are not entirely without action on a ray of polarised light sent through them. Finally, the diamond is pure carbon, and, as such, burns entirely away when heated to a sufficiently high temperature in the air, and more vividly so burns or glows away when heated in oxygen gas.

"The specimens I had to experiment upon were too light to possess appreciable weight, too small even to see unless by very good eyesight or with a lens, yet were, nevertheless, sufficiently large to answer the three questions suggested by the above properties.

"A few grains of the dust, for such the substance must be termed, were placed between a plate of topaz—a cleavage face, with its fine natural polish—and a polished surface of sapphire, and the two surfaces were carefully "worked" over each other, with a view to the production of lines of abrasion from the particles between them. There was no abrasion. Ultimately the particles became bruised into a powder, but without scratching even the topaz. They were not diamond.

"Secondly, some particles, more crystalline in appearance than the rest, were mounted on a glass microscope slide, and examined in the microscope with polarised light. They acted each and all powerfully in the manner of a birefrangent crystal. It seemed even in one or two of them that, when they lay on their broadest surface (it can scarcely be called a 'crystal face'), a principal section of the crystal was just slightly inclined to a flattish side of it in a manner that suggested its not being a crystal of either of the orthosymmetrical systems. Be that as it may, it was not a diamond.

"Finally, I took two of these microscopic particles and exposed them to the intense heat of a table blowpipe on a bit of platinum foil. They resisted this attempt to burn them. Then, for comparison, they were placed in contact with two little particles of diamond-dust exceeding them in size, and the experiment was repeated. The result was that the diamond particles glowed and disappeared, while the little particles from Glasgow were as obstinate and unacted on as before. I had previously treated the specimen I have alluded to as the first on which I experimented by making a similar attempt in a hard glass tube in a stream of oxygen, and the result was the same. Hence I conclude that the substance supposed to be artificially formed diamond is not diamond and is not carbon; and I feel as confident in the results thus obtained from a few infinitesimal particles that can hardly be measured, and could only be weighed by an assay balance of the most refined delicacy, as if the experiments had been performed on crystals of appreciable size.

"Not content with merely proving what these crystalline particles are not, I made an experiment to determine something about what they are.

"Heated on platinum foil several times with ammonium fluoride they became visibly more minute, and a slight reddish-white incrustation was seen on the foil. At the suggestion of Dr. Flight, assistant in this department, a master in the craft of the chemical analyst, these little particles were left for the night in hydrofluoric acid in a platinum capsule. This morning they have disappeared, having become dissolved in the acid, and on evaporation there is seen a slight white incrustation, on the capsule, of the residuary fluoride. I have, therefore, no hesitation in declaring Mr. Mactear's 'diamonds,' not only not to be diamonds at all, but to consist of some crystallised silicate, possibly one resembling an augite, though it would be very rash to assert anything beyond the fact that they consist of a compound of silica, possibly of more than one such compound."

Mr. Maskelyne concludes that "The problem of the permutation of carbon, from its ordinary opaque black condition into that in which it occurs in nature as the limpid crystal of diamond, is still unsolved. That it will be solved no scientific mind can doubt, though the conditions necessary may prove to be very difficult to fulfil. It is possible that carbon, like metallic arsenic, passes directly into the condition of vapour from that of a solid, and that the condition for its sublimation in the form of crystals, or its cooling into crystal-diamond from the liquid state, is one involving a combination of high temperature and high pressure present in the depths of the earth's crust, but very difficult to establish in a laboratory experiment."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 14.—"Modern Autographic Printing Processes." By THOMAS BOLAS, F.C.S.

JANUARY 21.—"Domestic Poisons." By HENRY CARR.

JANUARY 28.—"The Future of Epping Forest." By WILLIAM PAUL, F.L.S.

FEBRUARY 4.—"Trade and Commerce with Siberia, *viâ* the Kara Sea." By HENRY SEEBOHM.

FEBRUARY 11.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

FEBRUARY 18.—"The Euphrates Valley Railway." By W. P. ANDREW.

FEBRUARY 25.—"The Art of the Silversmith." By W. HERBERT SINGER.

MARCH 3.—"The History of Musical Pitch." By ALEXANDER J. ELLIS, F.R.S.

MARCH 10.—"Recent Advances in the Production of Lambeth Art Pottery." By JOHN SPARKES.

MARCH 17.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday Evenings, at eight o'clock :—

JANUARY 22.—"The Teaching of Physics." By Prof. PERRY.

FEBRUARY 12.—"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.

APRIL 8.—"Recent Improvement in Benzine Colours." By H. J. FRISWELL, F.C.S.

INDIAN SECTION.

Friday Evenings, at Eight o'clock :—

JANUARY 30.—"Herat." By Colonel G. B. Malleson, C.S.I. ADMIRAL SELWYN will preside.

FEBRUARY 20.—

MARCH 5.—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"Agriculture in India." By W. ROBERTSON, Superintendent of the Government Farm, Madras.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 3.—"Social and Commercial Prospects in the Transvaal." By the Rev. G. BLENCOWE (late of the Transvaal and Natal). Sir THEOPHILUS SHEPSTONE, K.C.M.G., will preside.

FEBRUARY 24.—"Art in Japan." By C. PFOUNDES. Sir RUTHERFORD ALCOCK will preside.

MARCH 16.—"Iceland and its Resources." By C. G. W. LOCK.

APRIL 6.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

CANTOR LECTURES.

The Second Course. "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S. :—

February 2, 9, 16, 23; March 1, 8.

LECTURE I.—FEBRUARY 2.

Sources of India-rubber. Chemical and physical properties. Behaviour with chemical reagents. Action of various solvents. Effects of heat, cold, and light.

LECTURE II.—FEBRUARY 9.

Mechanical and chemical purification. Working of unvulcanised caoutchouc. Formation of blocks, sheets, and threads. Elastic webbing. Other uses of unvulcanised India-rubber.

LECTURE III.—FEBRUARY 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates :—

April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 5TH...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. E. R. Robson, "The Non-Educational Work of the School Board for London."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Mr. Hormuzd Rassam, "Late Assyrian and Babylonian Research."
London Institution, Finsbury-circus, E.C., 5 p.m. Capt. Abney, "Solar Radiation."

TUESDAY, JAN. 6TH...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Tyndall, "Water and Air." (Lecture V.)
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m. Annual Meeting.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m. Annual Meeting.
Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, JAN. 7TH...Geological, Burlington-house, W., 8 p.m. 1. Rev. F. J. Blake, "The Portland Rocks of England." 2. Mr. D. Mackintosh, "The Correlation of the Drift-deposits of the N.W. of England with those of the Midland and Eastern Counties." 3. Mr. J. W. Davis, "The genus *Pleuracanthus*, Agass., including the genera *Orthacanthus*, Agass. and Goldf., *Diplodus*, Agass., and *Xenacanthus*, Beyr.
Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JAN. 8TH...Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Boyd Dawkins, "The Man of the Caverns."
Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Prof. Tyndall, "Water and Air." (Lecture VI.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, JAN. 9TH...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 7 p.m. (Juvenile Lecture.) Mr. W. H. Preece, "Recent Wonders of Light."
Astronomical, Burlington-house, W., 8 p.m.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, 8½ p.m. Annual Meeting.

SATURDAY, JAN. 10TH...Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m,

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FRIDAY, JANUARY 9, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

JUVENILE LECTURES.

The second of these lectures by Mr. W. H. Preece, on "Recent Wonders in Light," will be delivered this evening (Friday), at 7 o'clock. A report of the lecture will be printed in the *Journal* next week.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The Easter Term will commence on Tuesday, the 13th inst., at ten o'clock a.m. Private students desiring admission are requested to communicate with the Registrar forthwith.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

RECENT WONDERS OF SOUND.

By W. H. Preece.

DELIVERED 2ND JANUARY, 1880.

I have not brought you together to astonish you with new inventions, or to excite your wonderment at some of the advances that have been made of recent years. My principal object is to let every boy and girl who has honoured me with his or her presence this evening, see the advantages to be gained by knowing how to use his or her eyes and hands.

All advances of science are the result of experiment, and experiment is the simple mode by which new facts are brought to our knowledge. A great physician, some hundred years ago or more, lived in the town of Derby, and he was the grandfather of a very great man who lives now, Mr. Charles Darwin. This old doctor said, that "a fool is a man who never tried an experiment in his life." I am quite sure that there is scarcely a boy in this room who does not, every day of his life, try an experiment of some kind or the other, and therefore there is no fool among my hearers. Every boy has, at some time or other, taken a paper bag, such as the one in my hand, and after blowing it out has burst it between his hands with the view of startling his little sister, or raising a smile from the cook. When he has done this, he has performed an experiment; but it is one thing to experiment, and another thing to draw a lesson from such experiment; and it is towards the endeavour to exercise your thought, by carrying your minds from the natural effect to its cause, that I am more anxious to lead you than to anything else. For instance, every boy, as I say, has made an experiment, but has anyone asked himself why it is that clapping one's hands, blowing a whistle, or making a sound in this way (bursting the bag), produces the effect on the brain that is called sound? When the bag is blown out to its full size, and forcibly compressed, there is a condensation of air in it, and then by the bursting of the bag, an expansion, and by this sudden expansion, a disturbance of the air about us is produced, which has resulted in something being done between you and me. If I take this popgun and force down the handle rapidly, you hear by the report I have produced a disturbance in the air. Between that popgun and every ear in this room there has been a sudden vibration produced. We all know that when a clap of thunder is heard the windows shake; when, in church, the deep notes of the organ are sounded one can feel the pew vibrate; and those of you who in future years may travel to such places as the Falls of Niagara, will find that in the neighbourhood of the enomous roar of this water there is heard an incessant and constant vibration of doors and window sashes. Hence, when we have sound, we must have as a source of production, a sudden disturbance of air. There must be a medium to convey these vibrations, and that medium is the air itself. To appreciate sound, or know when it is produced, there is something to receive it, and that medium is the organ of the ear. It follows then that sound and vibration are concomitant, or similar things. To convey these vibrations to the ear, they are received by the air in which we live, and move, and have our being. This air forms an enormous ocean 50 miles deep, and we are nothing but crabs and lobsters crawling at the bottom of it. This air swathes our bodies, and, when it is thrown into vibration, it affects our ears, and this effect is what is called sound. What is this air? We cannot see it. We sometimes feel it, especially latterly, during the heavy gales of wind that have prevailed. Birds fly in it. It maintains the lights before us burning, and keeps us alive. We know that this air is composed of atoms and molecules. We will take no notice of the atoms, but will fix our minds on the molecules or clusters of atoms of which the air is composed. This room is the receptacle of more millions upon millions of these molecules than I could count if I were to keep on till to-morrow morning. Every little molecule of air is thrown into motion when sounds are produced, and every motion I make with my lips, and every sound I utter by such motion, strikes your ears, and produces the sound of my voice. To give you an idea how this is done, I have upon this board arranged a series or row of marbles. I have no doubt most of you are acquainted with that highly scientific apparatus, a marble, and have frequently experimented with it in various ways. That row of marbles represents a row of the molecules of air that exist between my mouth and your ears, and when I take a marble from the right hand end of the row, and let it fall back into its position again,

you will see that almost instantaneously the marble at the end of the left hand side of the row leaves its position for a distance and falls back again. If I take two marbles from the right hand and let them fall back, you will notice that two at the left hand are driven off, and so on. So with the molecules of air. Every time I utter a sound the molecules near my mouth are disturbed, and a similar disturbance takes place in your ear. You will see that the action through the row of marbles takes very little time indeed, but with the molecules of air the time taken to produce these movements is perfectly well known, and the movements are easily measured. The velocity or time that a sound takes to travel through the air is about 1,100 feet per second. I say "about," because it varies with the temperature. On those bright, brisk days, a short time ago, when we all enjoyed our skating, sound travelled at the rate of about 1,000 feet per second. On those hot, muggy, uncomfortable days, like yesterday, sound travelled about 1,100 feet per second. In water, sound travels very much quicker, being at the rate of 5,000 feet a second. With wood it is quicker still, being about 16,000 feet per second. So that the velocity with which sound passes through different media is simply dependent upon the character of the medium, and the ease with which the molecules composing it transmit each other's motion. Bearing in mind the fact that sound travels at the rate of 1,100 feet per second, you can all try an experiment the next time you hear thunder. Lightning travels at a rate which is practically infinite; it is, in reality, 186,000 miles a second, but it is so fast that you may regard it as instantaneous, and, therefore, the moment you see the flash you know it has just taken place. Sound, travelling at the rate of 1,100 feet per second, takes about 4½ seconds to travel a mile. So that, having seen the flash, if you count 1, 2, 3, 4, 5, and so on (representing seconds) till you hear the thunder, then if it occurs on your counting five, you know that the storm is a mile away, and you can put your head beneath the clothes and be perfectly easy. If, on the other hand, you see the lightning, and the crash follows immediately after, it is very near. But there is one thing very certain, that, having heard the crash, you are all right, for the lightning which caused it has passed away. The speed with which sound travels is the cause of having such things as echoes. Echoes are simply due to the reflection of sound. From the far end of the room, every sound I utter is reflected back to me, but, because the distance is so short, I do not hear any difference between one syllable and another. But if the wall were 1,100 feet away, or rather half that distance, then at the end of each second I should get back the sound that I utter. Hence, it happens that in large halls it is extremely difficult to speak, because the echoes are so confusing. In the Albert-hall, for instance, there is a certain spot on the platform where poor unfortunate speakers stand, and, unless they are up to the secret, they get confused in a series of sounds coming from all parts of the building. But when a speaker there knows what to expect, he regulates his voice, and the echo becomes a guide to him how to send his voice right away up to the ceiling. When I had the pleasure of lecturing there, I heard back every word that I uttered, and waited for it before I gave out a second, and the result was that I succeeded in filling the large area with my voice, though it is naturally not a very strong one.

The motion of these particles through the air is in itself an interesting study, but they are very complicated in their action. The nearest approach to the motion that I know of, to give you a mental picture of what takes place in the air, is the swaying of a field of barley. Many of you will remember how the gentle breezes blow the tips of the barley in extremely pretty waves, and the formation which these tips take is almost identically the same form which the molecules of air take when transmitting sounds. In fact, if it were possible to suddenly illuminate this room, and to enable you to see the condition of the molecules of the air, you would see them very much as you see the top of a field of barley, excepting that, as the molecules are so small, you would require an infinitely powerful microscope to see them, whereas in the case of fields of barley you can exercise your own eyes.

Sounds are produced by the sudden expansion of air. Sounds being transmitted by this wonderful material, air, we want something to receive the impacts—the movements—of these little molecules, and that is given to us by the ear. On the wall to my right, you will see a diagram representing a section of the human ear. Here is the outside of the ear, the shape of which we all know so well. Then there is the inner tubing, and a little way inside this tubing is what we call the drum of the ear. This drum is, in fact, a membrane, or disc (a small-sized drumhead), which is hit by the molecules every time they are disturbed by the utterance of sound. The character, or nature of the sound is simply dependent upon the way in which it is struck by these little molecules. There is a wonderful and beautiful system of bones that takes up these sounds again from the drum of the ear, and transmits them to the nervous system, and then to the brain, but we have not to-night to trouble ourselves with what takes place beyond the drum of the ear itself, nor should I attempt to show you, for one very good reason, that I do not know myself, and I do not think that anybody has yet attempted to solve the mystery, how it is that the motion of the molecules of the air is transmitted to the brain.

If anybody is anxious to know what sound is, there is a very simple experiment that you can all try. If I put my watch to my ear I hear the ticking of the watch through those molecules hitting the drum of my ear. If I place the watch in my mouth, so as not to let the teeth touch it, I hear nothing, but if I bite the watch, then the ticking comes out as clearly as when the watch is placed close to the drum of the ear, and in this instance the sound is transmitted to the brain, not through the drum of the ear, but through those complicated bones that support the drum and form part and parcel of the organ of hearing.

We have now to talk about the character of sound. We have seen how it is produced. We have seen how it is transmitted and how received. Here is a box which I will shake, and you hear a sound, which, I dare say, many of you will think represents the familiar sound of your money box, but it is caused by nails. Here is a box containing a different arrangement

to nails, and you will recognise it as an accordion, from which I can draw forth sound in the shape of music, though I am not player enough to give you a tune. Another sound, pleasant to the ear, may be produced (as you see I now do) by ringing glasses on your dessert table; you can take your finger-glass and just rub it round the edge, and a very sweet sound is at once heard. I have myself seen a man in the street playing on an arrangement of glasses in this manner with the most beautiful effect. From these illustrations we see, therefore, that sound can be divided into noise and music. But music itself possesses very distinct and separate qualities, and I want particularly to impress upon you these different qualities of sound, because upon them depends your knowledge of the instruments that I am going to bring before you.

First of all, the difference in "pitch" of a note is produced by the number of times that the molecules hit the ear in a given time. Here I have a tuning fork, which is so constructed that it wags backwards and forwards 256 times every second, and consequently it sets the molecules of the air in motion between it and you, and you get a beat on the drum of your ear 256 times every second, and these beats represent the sound known as "do." Here is another tuning fork representing "mi," which beats 320 times every second. Here is "sol," which will disturb the drum of your ear very fiercely 384 times a second. Here is our friend "do" an octave higher, that hits you 512 times a second. In order to show you a little more clearly that these effects are produced, we have here a disc that has a series of holes pierced through it, and I have an india-rubber tube through which I can blow, but, blow as I will, you do not hear any sound. If I allow my breath, as it makes its exit through the tube, to pass through the holes in the disc, as it revolves, my breath is broken up into a series of pulsations or blows, so that again you get your ears hit with the proper number and rate to produce notes. [The disc is known as the syren, and the "scale" was played once or twice both slowly and rapidly upon it.]

Here is a little contrivance in which, instead of exerting my own lungs, I can bring an artificial pair of bellows into play, the air from which causes a little disc to rotate, and the higher the speed at which this disc rotates (by continuing the pressure of the bellows) the higher the pitch; and by pressing the bellows slower and slower the note becomes lower. Here is another instrument that shows you the same effect as the one just exhibited, and I want you to thoroughly understand this fact, because it lies at the root of all our microphones and telephones, and therefore it is an essential thing that you should grasp and see for yourselves, with your own eyes, not merely the eyes of your body, but the eyes of your mind, these wonderful things that take place to produce sound. This is simply a little iron disc which I bring into contact with the edge of a toothed wheel. When the wheel is turned you hear sound produced. As the velocity is increased, the pitch of the sound is higher and higher, till you hear a perfect shriek, then on the speed coming down the pitch becomes lower. You will understand by these illustrations that the pitch of a note depends upon the number of times the drum of your ear is hit by the molecules of air. But I can do more, I can almost make you see the sound. Here is an instrument that is called a phonoscope, and it is the invention of a gentleman named Edmunds. Here we have a glass tube that has been exhausted of air and supplied with gas. We send through that tube currents of electricity, and Mr. Ladd will sing, cough, laugh, &c., and you see a flash of light in the tube for every note. This is an ocular demonstration of the fact that every vibration of the disc produces the effect that leads to sound.

It is worth noticing that the lowest note which can be heard by the human ear is produced by vibrations of 16 to the second—the highest is produced by 38,000 vibrations to the second; so that the human ear has a limit between 16 blows per second and 38,000 blows or vibrations per second. But the human voice itself is only capable of producing vibrations between 65 per second and 1,044 per second, and the highest double C of some of our chief sopranos only means a little more than a thousand vibrations per second. But yet the ear can detect sounds higher than that of the highest voice. There are some ears that can hear the bats cry; there are some that cannot.

There is a very interesting inquiry being carried on just now by Sir John Lubbock, on the habits and manners of ants, and that gentleman has shown beyond question that ants have a mode of communicating their ideas to each other. An ant strolling about may come across a piece of meat, and he will hurry back and say something to the first chap he meets, and they will go together to the meat and will carry it to their nest. The results of Sir John Lubbock's watching of the habits of these little fellows are most wonderful. We are quite sure they talk, or have some mode of conveying their ideas, but if it is by sound, the number of vibrations are so excessive that the human ear cannot detect them. The microphone, and all kinds of contrivances have been tried to ascertain if they converse, but, so far, it has all been of no use. We have even gone so far as to make a special little instrument that will vibrate nearly 200,000 times a second, but still the little rascals have defied the investigation. There is yet a hope that, by perseverance and observation with special instruments, Sir John may one day find them out, even if not be able to convey their ideas to us.

The first fact that I brought to your notice is that sound varies in pitch. The second quality in which it varies is, that of loudness, and loudness is produced either by the increase of amplitude, that is given to the motion of these molecules, or to the quantity of air that we throw in motion. For instance, if I take a small tuning fork and hold it up in the air, you do not hear, but if I take a longer fork, you, perhaps, hear it because its vibrations are greater, and it causes a greater amplitude, or spreading out, of the waves of air. But if I take a little contrivance I have here to increase the quantity of air thrown in motion, you can hear. This is done by placing the tuning fork on a small piece of wood, extending from the apex of a paper cone. So if I take a larger surface, a larger paper cone, there is a louder sound, as you can hear. If I take a still larger fork, and hit it upon the table, and hold it in the air, you hear the sound without the aid of a magnifier, as I may term it; there is a

considerable difference in the loudness of the tone, owing to the greater quantity of the air that is thrown into motion. We can also increase the loudness by taking a conical shaped roll, and speaking into it at the smaller end. It is by taking advantage of this fact, that this elegant and scientific apparatus, known as a speaking trumpet, has been utilised for carrying orders to different parts of a ship.

The next point connected with sound that I want to call your attention to is its quality. You are all acquainted with this extremely beautiful musical instrument in my hand. Perhaps some of you may think it is an expensive flute, but, between ourselves, I am bound to tell you that I paid a penny for it, and, though modest in price, good music may be got out of it. Here is another musical instrument — a fiddle, and, if I were Paganini, or one of those three fellows who played before "Old King Cole," I could give you some good music, but as it is the first time I have handled a fiddle, I will only just touch it that you may hear the kind of sound it produces. I am playing the note C on this fiddle. I now take the whistle and blow the note C; and, so on, I may go through all the musical instruments—cornet, clarionet, accordion, Jew's-harp, &c.—and sound C, and although each instrument will strike your ears exactly the same number of times per second to produce the note C, nevertheless, the notes differ very much in the particular form that distinguishes one instrument from the other. This quality is due, not to the number of times that your ear is struck; not to the strength of the blow, but to the form in which it is struck. Here is a little instrument by which I hope to show you what I mean. It is a spring, with a silver bead on the top. The silver bead reflects, as you see, a spot of light. You will see that when I move the bead straight up and down, or to and fro sideways, a line of light only is reflected, but when I vibrate it, and move it towards you, the most beautiful waves are reflected. The human voice is one of the finest musical voices ever constructed; in it you have all the beautiful tones of music. But you never find two voices sound alike; you never hear a man speak twice in exactly the same way; and the result is that the human voice differs very much more than any other form of apparatus, but it does so simply because of the construction of the mouth, the size of the tongue, the formation of the teeth, and the way in which one breathes at the time air is taken into the lungs. Any slight difference in these things varies the form of the air when it passes from the mouth of the speaker to the ear of the listener. I will illustrate this by my Jew's-harp. If I place the harp in my mouth, and shape my mouth for the sound "O" to be given out, on striking the harp you hear that sound given; if I alter the shape of my mouth, "A" is given, and so on.

We have spoken of sound varying in pitch, loudness, and quality. We have now to speak of the impression of sound. We want to impress the sound on something. If any of you, when at home, will take the trouble to open the top of the piano, particularly if a grand piano, and press down the soft pedal, and sound on the middle note the vowels *a*, *o*, *e*, you will find these vowels come back to you perfectly distinct. You all must have noticed that when anyone sings to a piano there are certain notes that always vibrate in sympathy to the human voice, and sounds are heard back again. It has been said that Lablache, one of the greatest deep bass singers we ever had, was able to sing a note so loud that he could crack a tumbler, and did actually break one before his audience.

To illustrate this impression of sound, I must borrow a hat. Here is a hat, to the crown of which I will fix a little apparatus, consisting of a spring, which when it vibrates makes contact in a telegraphic circuit, in which two telephones are fixed at the far end of the room. The spring vibrates when the corner of the hat vibrates, and if I speak into the hat the sounds are given off by the telephones. [The audience near the telephones recognised the sounds.] The crown of a hat is not essentially necessary to show you this. A disc of thin iron, ebonite, or parchment, about three inches in diameter, will, under the influence of my voice, vibrate in the same way; and I want to show you that they not only vibrate in this manner, but they do so just the number of times required to make the note spoken, just the amplitude required to produce loudness, and just in the form required to produce quality. My friend, Mr. Stroh (to whom I am so much indebted each time I have had the pleasure of being here), has made one of the most beautiful apparatuses that I know of to illustrate this point, and he has kindly brought it to illustrate my lecture. It is a phonoscope. We have a magic-lantern, in front of which is a thin disc, upon which there is a mirror which reflects a spot of light on the screen on the wall, and it is to the movements of that reflected spot of light that I want to call your attention.

[The gas was then turned down, and Mr. Stroh caused the spot of light to rotate rapidly forming an unbroken ring of light on the screen. He then spoke the vowels to the disc, and each vowel caused its representative variation in the edge of the circle of light. Coughs, laughing, &c., also were shown to break up the rim into greater or less zigzag projections.]

There you have a perfect representation of all the different qualities and properties of sound. I want now to speak of the transmission of sound, and I must claim your indulgence, for the time is going very fast, and I cannot dwell on the experiments. You are all familiar with speaking tubes, as used at the present day, for conveying orders from room to room in the house, hotel, or office. The ancients employed speaking tubes in connection with their idols, and used sometimes to make their oracles tell the most wonderful stories. The gentleman whom I mentioned in the opening of my lecture, Dr. Erasmus Darwin, was one of the first in England to construct a speaking tube. He fixed it between his dining-room and his kitchen—very near the fire-place in the latter. A patient sent his servant one night to the doctor for assistance, and while the man was sitting by the fire in the kitchen waiting for his message, he heard a sepulchral voice, coming apparently from the fire, say, "I want some coals," and he jumped up and ran away, and told all the neighbourhood that Dr. Darwin was a magician. We have a mode of producing and transmitting sound that is due to the late Sir Charles Wheatstone. Between a room down-stairs and here is this deal rod,

which is resting upon a musical-box. As it is, you hear nothing at all, but if I take this butler's tray and place it on the deal rod, you hear the musical-box playing, which disappears on my taking off the tray, and reappears on my again placing it on the rod. It is a good experiment; but I must pass on, as it is difficult to keep pace with time, which, as you know, waits for nobody. This is one of the first forms of telephone, invented as far back as 1819. The sound is reproduced in that case only from the room below. We are now going a little further, and will transmit and reproduce sound from the City. Between this room and the City there is a telegraph wire, and on that wire telephones have been fixed. There are numerous forms of telephones. The diagrams on the wall will give you some idea of what they are. I have shown you Wheatstone's mechanical telephone. There is a form of string telephone that you are all, I have no doubt, acquainted with, and a very beautiful scientific apparatus it is, and one through which conversation can be carried on for a considerable distance. But Professor Bell, in 1876, formed an instrument by which sound could be reproduced at a much greater distance than by any means previously known. Reiss, a German schoolmaster, in the year 1860, had done precisely what I showed you with the hat, and, in fact, I ought to have told you that the hat arrangement was nothing but a Reiss telephone. But Bell went very much further than Reiss. He was able to reproduce speech, and the electric signals coming through the wire coming into this room from the City are transmitted with just the amplitude and form that I showed you on the disc, and they reproduce all the qualities of sound, either of musical instruments or the human voice.

Still further improving on what had been done before, Professor Hughes invented the microphone, an instrument by which the motions of the air, the sonorous vibrations as they are called, act directly on a portion of the electric circuit, and vary the electric currents in all their beautiful waves. The instrument which I have before me is one of Mr. Louis Crossley's (of Halifax). It is a form of transmitter, based on Professor Hughes's discovery, and the arrangement between this room and the City is just what you see on this diagram. We now ask the man in the City to say a few words—and, there, you hear what he says. His voice in the City is setting electric currents flowing which produce vibrations in the air. The sonorous vibrations in the City impinge on a disc, just as those of my voice did on the hat; that disc produces currents of electricity which vary in number, form, and quality. These currents of electricity traverse the telegraph wire between the two rooms, and are received on the instrument here by a little magnet, and this magnet causes the disc at this end to vibrate just in the same way as the disc vibrates in the City. I repeat, then, that what a telephone does is this. A disc is thrown into vibration by your voice, just as you saw Mr. Stroh's phonoscope thrown into vibration. These vibrations are transformed into currents of electricity, which come to this distant station, and here cause another disc to vibrate in exactly the same way, and throw the air of this room into similar vibrations, as the air is vibrated in the room in the City, and the effect is that we hear apparently the voice of the man at the sending place. If wires were clear, that is, free from what is called induction, distance would be practically of no consequence. I have spoken between Holyhead and Dublin in the same way that I am speaking to you. I was in Holyhead, my friend in Dublin, and I talked so nicely that he actually told me that he could smell my cigar. In America they have talked through a greater distance. There was an account in the paper the other day of a conversation being held at a distance of 2,000 miles. In fact, Professor Bell and myself spoke through "resistance," as it is called, that represented 10,000 miles, and the wire through which we talked was within itself really a telegraph 10,000 miles long. There is no doubt whatever that, if we had a telephone or a wire from here to the moon, and if any of you were to follow Jules Verne's hero and go to the moon, we should be sure to talk comfortably, and without the slightest difficulty.

I want now to say one word about talking machines. There are many such. There is Faber's, which was introduced in England in 1843, and is now in England, but not on public show. We can all make talking machines for ourselves if we like. Here is a penny trumpet. If I close the end with my hand and, on blowing through the tube, imitate the motion of the lips with my hand, I can make it sound "ma-ma." Not a very good one perhaps, but, nevertheless, it shows you that, by the proper manipulation of india-rubber tongues and lips, or things of that kind, it is possible to construct a machine to emit sounds representing speech; but Mr. Edison has far transcended anybody else, and by taking advantage of this power that we have of making discs represent in pitch, in loudness, and in quality, the sonorous vibrations, he has been able to reproduce the human voice with wonderful exactitude by the phonograph. Here is a phonograph, or talking machine. Its construction is illustrated by the diagram on the wall. The diagram is not exactly a representation of the particular one before you, which is regulated by clockwork. You will notice the disc into which words are spoken. Here is a cylinder upon which lead foil is fixed, and when I speak into that disc I cause it to vibrate. The vibrations cause a little point to impinge on the lead. On this lead dots, and ruts, and waves, and curious marks are made, and when these marks are caused to go a second time over the same ground with the disc in contact with, or again pressing on them, they reproduce the sounds first spoken. [Several sentences were spoken into the phonograph, and the sounds of coughing and laughing were sent into it, and came out again clearly.]

We have the pleasure this evening of having amongst us a gentleman who has recently returned from the Cape, and whose name in that part of the world is a household word. I mean, Sir Theophilus Shepstone. He can speak Zulu, and I have no doubt that many of you will be glad to hear the sound of the Zulu language. But we are also anxious to know if the phonograph itself will reproduce the Zulu tongue, because in the Zulu and Kaffir languages there are sounds we do not know on this side of the globe—curious clicks. [Sir Theophilus Shepstone spoke a few sentences in

Zulu to the phonograph, which he said repeated the words very faithfully.] I am indebted to you all for your very kind attention to-night to what I have said. I have led you up from the mere elements of sound, from sonorous vibrations to the way in which you may "waft a sigh from Indus to the Pole;" and to the mode by which we can even reproduce voices that are still. But although these are wonders, and recent wonders of sound, I do not want you to forget that they are the outcome of experience, and the wish that I have in giving this short course of lectures is simply to induce boys and girls to use their eyes and hands in observation and experiment.

CANTOR LECTURES.

THE CHEMISTRY OF BREAD-MAKING.

By Professor Graham, D.Sc.

LECTURE III.—DELIVERED DECEMBER 8, 1879.

As there are many millers present for the first time this evening, from different parts of the country, I think it desirable to give a short *resumé* of the latter part of the last lecture, where I was discussing the albuminoids of wheat, because it is as needful for the miller to understand the respective characters of the different albuminoids of wheat as for the baker; indeed, as milling precedes baking, it is perhaps even more so.

At our last meeting then, I pointed out to you that the albuminoids of the cereals differed greatly in their character, and that wheat is remarkably rich in those forms of albuminoids which do not dissolve in water, and which agglutinate together, and that it was on this account that wheat flour is, of all flours, that which is pre-eminently fitted, on account of the viscid resisting nature of its gluten, to lend itself to the action of carbonic acid in raising and piling the loaf, whereas the other cereals are very inefficient in that respect. Mr. Lewis, at present, is taking some of that crude gluten, and is kneading it with a little water, and he will presently show you the wonderful elastic power of this material. The action of the water on the particles of crude gluten is to cause them to cohere together, forming a tough elastic mass. We saw from the analysis before us at our last meeting, that wheat differs not so much in the amount of the total albuminoid principles, but rather in the nature of those albuminoids.

The albuminoids in cereals may be very conveniently divided into two chief categories, those which are soluble in water, and those which are, at least at first, not soluble. Those which are insoluble, consist of glutin and fibrin; glutin differs from fibrin, inasmuch as it is slightly soluble in cold water—more so in hot water; but that which distinguishes it from fibrin is that it dissolves in spirits of wine, whereas the other material, fibrin, which constitutes 71 per cent. of crude gluten, does not. There are yet other forms of albuminoids, but these are soluble in water. They consist of albumen, which, of course, is soluble in water. It is precipitated by strong alcohol and by boiling, and differs therefore from the next member, legumin, which resembles albumen in every other respect, except that on boiling it is not precipitated. Lastly, there is a form of soluble albuminoid matter, contained more especially in the husk or skin of the berry of the wheat, which has been called cerealin. This is a very active diastasic ferment, and resembles to a great extent the peculiar diastasic ferment which is obtained from malting barley, and infusing the result of that malting.

These three varieties of soluble albuminoids are found, one or more of them, more or less in all seeds, and for this reason. You remember I pointed out to you the nature of the caryopsis of barley, and I compared that with the rich, thick, fleshy cotyledons of the bean and pea, and I said that when you considered the bean and pea or the caryopsis of the barley and wheat, we have in either case a mass of matter stored up by the parent plant for the future nourishment of the young embryo lying at the bottom in both cases. Now, the function played by these soluble albuminoids is to convert the insoluble cellulose matter, the woody fibre, and after that has been to a great extent used up, then to attack the starch, the amylaceous matter, in the grain or in the seed, and convert it into soluble nourishment for the young growing embryo. The amount of soluble albuminoids we shall presently see, in well-matured and well-garnered grain, is not large, whereas, in ill-matured grain, and still more, of course, in sprouted grain, the amount of these albuminoid ferments is considerable.

I shall call your attention now to a very interesting experiment, because we shall find that it has a considerable bearing upon the very ingenious process of fermentation that bakers have discovered for themselves. If we take yeast, which is a powerful and active ferment when added to dextro or lævo-glucose, or maltose sugar, and add it to the unbroken starch cells, we shall find that, even after an hour in the cold, there is comparatively little action; whereas if we add to that yeast, and that unbroken starch—ordinary starch before it is boiled, and while the cells are not burst—a small quantity of the cold water infusion of any of the cereals, we shall find that, inasmuch as that cold water infusion contains soluble albuminoids, these are acted upon by the yeast, and are converted from their complex molecular structure into bodies of less complexity in their structure. In other words, they are less colloidal or gummy; they are more mobile. That peculiar molecular disturbance having been brought about, among the soluble albuminoid bodies in the cold water infusion of any of the cereals, by the peculiar action of yeast, these degraded albuminoids have the power of passing through the lining of the starch cell, and in that way the hydration of the starch is brought about, so that maltose sugar and dextrin of the various kinds I have told you about are formed; whereas, if we do not make use of these soluble albuminoids obtained from a cold water infusion of one of the cereals, if we take starch itself unboiled, we shall find that yeast has, in the same time, comparatively little action. Now, that is a matter of considerable interest, and we shall find that the baker has acquired all that knowledge practically long ago. I am only pointing it out to you now on account of its scientific interest. Mr. Lewis has, in one tube, some water, unbroken starch cells and yeast; in the other, in addition to the yeast and starch, he has added a small quantity of cold aqueous infusion of flour. These two tubes

have stood one hour, and on testing a filtered portion of each, you will find that, whereas the yeast and starch alone have no action, or but little, on Fehling's solution when boiled with it, that in the other case, where a little cold infusion of flour was added, the Fehling's solution will show considerable reduction, proving that sugars have been formed by the intervention of the soluble albuminoids of flour [The experiments showed a marked difference.] We may gather, then, from this that the yeast cell is itself unable to pierce the starch cell, and that the action brought about by the yeast is indirect; by first of all degrading the form of the soluble albuminoids, and then causing them to ooze through the sac or wall of the starch cell.

The tendency of all albuminoids, even those which are insoluble in water, and even that which is the most complex in its structure, namely, fibrin, is to degrade, to become less and less complex, and ultimately, of course, to become soluble in water. The degradation of molecular structure is communicated to the complex molecular structure of starch, so that the complexity of the starch undergoing the peculiar degrading action which goes on in the albuminoid molecule is itself converted into molecules less complex than starch, namely, into maltose and dextrin; in some cases there may be also the production of other sugars. We see, then, that the albuminoids are powerful degraders, or breakers down of the complexity of molecular structures. But that is not the only interesting point connected with nitrogen. Curiously enough, we speak of nitrogen as being inert, and as being merely used as it were for the purpose of diluting the oxygen of the atmosphere, hence we are all very liable to look upon nitrogen as playing a comparatively unimportant *rôle* in the phenomena of nature; and yet, strangely enough, were it not for the action of nitrogen, or rather of the compounds of nitrogen, there would be no life whatever in this world; there could be no simple cell even built up without the action of this marvellous architect, the nitrogenous compound. Every cell structure, and of course every large aggregation of cell structures, such as an oak tree, or a man, containing many millions of cell structures, is all built up by the wonderful agency of nitrogen, or rather of its compounds. But while nitrogen is so important an agent, so marvellous a builder up, it is for very similar reasons equally powerful in breaking down. Wherever you have albuminoids present, if there be moisture sufficient, and if there be warmth sufficient, there you have the agent ready for degradation. And hence it follows that man has been obliged to use two chief methods for the purpose of preventing this wonderful degrading power possessed by albuminoids. One method man adopts is heat. By the simple action of heat, some albuminoids are rendered insoluble, and, therefore, inert. You know that if you take ordinary white of egg and boil it, you will, to some extent, prevent the degradation of the albumen, and it will last, or withstand putrefaction, longer than if you had not so boiled it. Heat, together with drying, is a still more powerful method of preventing the attack of of these albuminoids. If you were to take perfectly pure cellulose, which exists so largely in woody structure—if it were absolutely free from all kinds of albuminoids—you would find even in moisture it would not decay; it would last for ages, I may say; but we also know perfectly well that ordinary wood decays rapidly, especially if there be moisture. Now, the plan adopted in order to overcome this tendency to decay, is either to heat the wood, so as to char a portion of it, as used to be done when wood was charred on the outside to convert it into charcoal. That plan, however, has been replaced to a great extent by the still more efficacious way of acting on the albuminoids so as to precipitate them. Tannic acid and creosote precipitate the albuminoids, and that is why the leather maker uses the tannic acid in oak bark or Bombay cutch, and why railway companies take care to creosote their sleepers. The creosote precipitates the albuminoid matters, and therefore those albuminoid matters are not able to degrade the cellulose matter of the wood. So in the same way fish is cured; the Finnon haddock is preserved for a certain time by the action of smoke; hams are also so preserved for a certain time. Other methods have been employed, such as the use of salt, and you will find that the baker has made use of this agent to prevent, to some extent, the degrading action of the albuminoids. The Egyptians, in the preparation of their mummies, had recourse to the same system, partly by drying and partly by the employment of certain aromatic principles, so that we find that heat, especially dry heat, is one of the means by which we can prevent the degrading action of albuminoids. The other method consists in the employment of chemical reagents, such as corrosive sublimate, tannic acid, creosote, and other matters of that kind, which prevents their activity by the precipitation of albuminoids. We shall presently see more of this when I come to speak of the rationale and object of the kiln-drying of grain.

We have seen the great diversity in character of the albuminoids found in the different cereals, and I wish to draw your attention this evening to the degrading influences which are brought about in the character of the albuminoids of wheat by climatic influences. I have here the result of some researches of the eminent chemist, Péligot, on different wheats, taken chiefly fromhis own country, but to some extent from countries outside France. (See next page.)

By looking at this table we shall learn some very useful facts. In the first place, if we take the analysis of Flemish wheat, we find the insoluble albuminoids are 8·3, the soluble 2·4; in the case of Odessa wheat there are 12·7 insoluble and 1·6 soluble; Poulard blue, 8·7 insoluble and 1·9 soluble; in the case of another variety of Poulard wheat we have 13·8 insoluble and 1·8 soluble. He also gives the analyses of the same wheat, but the product of a very dry year, in which the soluble albuminoids are only 1·4. I wish to draw your attention particularly to two or three points in this analysis. First of all, by dividing the insoluble by the soluble, so as to convert the soluble into unity, we shall have the following ratio:—In the case of the Flemish, the ratio of insoluble to soluble is 4½ to 1; Odessa, 9 to 1; Poulard, 8½ to 1; Midi, 10 to 1; Polish, 12½ to 1, a very large ratio; Hungarian, 8½ to 1; Egyptian, 14 to 1; Spanish, 6 to 1; and Taganrogg, 10 to 1. We shall see

Analyses of Wheat (Péligot).

	Flemish.	Provence.	Odessa.	Hérisson.	Poulard Roux.	Poulard Bleu.	Poulard Bleu. Dry year	Midi.	Polish.	Hungarian.	Egyptian.	Spanish.	Taganrogg.
Water	14·6	14·6	15·2	13·2	13·9	14·4	13·2	13·6	13·2	14·5	13·5	15·2	14·8
Fat	1·0	1·3	1·5	1·2	1·0	1·0	1·2	1·1	1·5	1·1	1·1	1·8	1·9
Insoluble Albuminoids	8·3	8·1	12·7	10·0	8·7	13·8	16·7	14·4	19·8	11·8	19·1	8·9	12·2
Soluble Albuminoids	2·4	1·8	1·6	1·7	1·9	1·8	1·4	1·6	1·7	1·6	1·5	1·8	1·4
Dextrin	9·2	8·1	6·3	6·8	7·8	7·2	5·9	6·4	6·8	5·4	6·0	7·3	7·9
Starch	62·7	66·1	61·3	67·1	66·7	59·9	59·7	59·8	55·1	65·6	59·8	63·6	57·9
Cellulose	1·8	..	..	..	..	1·5	..	1·4	..	..	..	..	2·3
Saline Matter	..	..	1·4	..	..	1·9	1·9	1·7	1·9	..	..	1·4	1·6

afterwards the importance of this to the miller when he has to consider the best method of mixing his wheats, for the purpose of producing a high-class flour. A very interesting point about these analyses of Péligot is this. I have not had an opportunity of referring to the original paper, and therefore I do not know whether he himself pointed out this interesting relation or not, but if you compare the soluble albuminoids with the amount of what he calls dextrin—of course the methods of analysis 36 years ago were not quite so perfect as we have now at our disposal—but still, taking this dextrin, which is now called maltose, together with dextrin, and comparing it with the soluble albuminoids, you will find a very strange ratio appears, and which is very constant throughout. The ratio of soluble albuminoids to dextrin in the case of Flemish wheat is 1 to 4. Taking the Odessa, which is so very different in character to the Flemish, so large is the amount of insoluble albuminoids compared with that in Flemish, still we have also the ratio of soluble albuminoids to dextrin as 1 to 4. In the case of Poulard blue, there also we have 1 to 4, and so you will find in all cases 1 to 4, until we come to the Hungarian, where the ratio is not quite 1 to 4, but 1 to 3½. This, probably, is due to some slight error in the analytical process, not to any real difference in the nature of the compounds formed. So it goes on again in the Egyptian and Spanish as 1 to 4, until we come to the Taganrogg, and there it is 1 to 5½. Possibly, this is also due to some error of analysis. With this exception, in a long list, we have the ratio of soluble albuminoids to the dextrin always as 1 to 4, evidently indicating some definite combination of the albuminoid matter with the sugar bodies.

I wish to draw your attention now to some important results published a good many years ago by Messrs. Lawes and Gilbert. Doubtless, to some of you the names of Lawes and Gilbert are well known, but to those who are not so well acquainted with them, I may say that the agricultural interests of England lie under a great debt to the public spirit and enterprise of Mr. Lawes, who has for more than 30 years spent some £4,000, if, indeed, it is not nearer £5,000, a year, on an elaborate series of researches, not merely into the influence of season upon wheat, but into an immense number of matters connected with agricultural chemistry. He has been most ably assisted in this great national work by his scientific *collaborateur*, Dr. Gilbert.

Influence of Seasons on the Character of Wheat Crops. (Lawes and Gilbert.)

Harvests.	Particulars of the Produce.				Composition of Grain.			Composition of Straw.		
	Total Corn and Straw per Acre in lbs.	Per cent. Corn in Total Produce.	Per cent. Dressed Corn in Total Corn.	Weight per bushel of Dressed Corn in lbs.	Per cent. Dry (212° F.).	Per cent. Ash in Dry.	Per cent. Nitrogen in Dry.	Per cent. Dry (212°)	Per cent. Ash in Dry.	Per cent. Nitrogen in Dry.
— 1845	5,545	33·1	90·1	56·7	80·8	1·91	2·25	..	7·06	0·92
+ 1846	4,114	43·1	93·2	63·1	84·3	1·96	2·15	..	6·02	0·67
1847	5,221	36·4	93·6	62·0	..	..	2·30	..	5·56	0·73
— 1848	4,517	36·7	89·0	58·5	80·3	2·02	2·39	..	7·24	0·78
+ 1849	5,320	40·9	95·5	63·5	83·1	1·84	1·94	82·6	6·17	0·82
\ 1850	5,496	33·6	94·3	60·9	84·4	1·99	2·15	84·4	5·88	0·87
+ 1851	5,279	38·2	92·1	62·6	84·2	1·89	1·98	84·7	5·88	0·78
— 1852	4,299	31·6	92·1	56·7	83·2	2·00	2·38	82·6	6·53	0·79
— 1853	3,932	25·1	85·9	50·2	80·8	2·24	2·35	81·0	6·27	0·20
/ 1854	6,803	35·8	95·6	61·4	84·9	1·93	2·14	83·7	5·08	0·69
Means	5,053	35·4	92·1	59·6	82·9	1·98	2·20	83·2	6·17	0·82

On referring to this table, you will notice that I have marked certain years, 1846, 1849, and 1851, with a +. Those years were remarkable for the dryness of the summer, the great amount of heat, the long continued heat, and the favourable conditions, not merely in the maturing period, but also in the harvesting period. If we look to the figures there given us by Lawes and Gilbert, we shall find, firstly, that the total weight of produce per acre is very high; secondly, that there is a high ratio of dressed corn to the total weight of corn; and, thirdly, that there is a high relative weight of corn. It is put here in pounds per bushel, and those who are well acquainted with agricultural matters will see, of course, that 63 lbs. per bushel, or 62½ lbs., indicates considerable excellence. Now, while the harvest was a favourable one, and the crop was good, we find that the amount of ash in the grain of 1846, was 1·9; in 1849, 1·8; in 1851, 1·89; which are low numbers compared with what we shall find in the bad years. But that is not all, a high produce or a valuable crop, and a high state of maturation of the grain, in other words, considerable excellences in the wheat, are accompanied by a comparatively low ratio of nitrogen—in 1846, 2·15; in 1849, 1·94: and in 1851, 1·98.

Now, let us take the other aspect of the question. The bad years are marked with a —; 1845 was a bad year; 1848, the year of political troubles, was also a year of great trouble to the farmers; 1852 and 1853 were also bad years. Now, if you look at these years, you will see that whilst the total corn is low, the weight of dressed corn is also low. In one year it is only 58 lbs. to the bushel, and in another case 50 lbs. But if we consider the ash, we find it is comparatively high. Take the case of 1848, which is a comparatively bad year, it is 2·02; in 1852, 2·0; in 1853, 2·24; and so on. The nitrogen is very high as well as the ash—I should say the ratio or per-centage of nitrogen was high, not the actual amount produced per acre, but there is a high ratio to the corn itself —in 1845, 5·25; in 1852, 2·38; in 1853, 2·35. Consequently, you see that a high ratio of nitrogen, so far from being coincident with a good character of wheat, is rather coincident with a bad character of wheat, and the same applies to the ash; a high ash is rather indicative of a low quality of grain.

The analyses, given by Dr. Gilbert, were made after drying the corn, so that there is no moisture given here for you to compare with Péligot's results, but if you look at Péligot's results, you will find about 14 per cent., or about one-seventh of the whole, consist of water. If we deduct this one-seventh from the nitrogen column of Lawes and Gilbert, we shall then obtain, by simply multiplying what remains by 6·33, the amount of albuminoids, as in the instances given by Péligot. Now, in the years 1846, 1849, and 1851, when that correction is made, if we compare Lawes' and Gilbert's with Péligot's results, we find that, in those three years, 10·85 was the average amount of the total albuminoids, soluble and insoluble put together. We see in the years 1845, 1848, 1852, and 1853, the bad years, that the average, total amount of the albuminoids, soluble and insoluble, amount to 12·7. Thus, therefore, we find that the wheats of the bad years have two per cent. more albuminoid matters than the wheats of the good years. In other words, wheats of bad elaboration have the greatest amount of nitrogen. That, at least, refers to our own country; and not only is the amount of nitrogen or albuminoids high in bad years, but there is one other very serious matter for the miller, namely, that these albuminoids are not well elaborated. A considerable quantity of them are soluble, like cerealin and albumin, and are high in proportiou to the insoluble variety that the miller or baker requires.

I have also here a series of results obtained by Mr. Brown, Demonstrator in the Laboratory of Chemical Technology of University College, for the purposes of these lectures, on the influence of moisture in the process which bakers submit the flour to when they add water at a certain temperature—100° Fahr., in degrading some flours compared with other flours.

Infusion Products of Flour. (Henry Brown.)

	Cold.	2 Hours.	4 Hours.	8 Hours.
Vienna Whites.				
Maltose	trace.	2·41	3·65	4·09
Dextrin	trace.	2·17	2·79	4·35
Soluble albuminoids	0·76	0·58	0·76	1·29
	0·76	5·16	7·20	9·73
Best Whites.				
Maltose	none.	1·57	2·04	3·41
Dextrin	1·21	1·48	2·74	2·85
Soluble albuminoids	0·71	0·58	0·31	1·54
	1·92	3·63	5·59	7·80
Best Households.				
Maltose	1·00	1·36	4·09	3·93
Dextrin	1·13	2·46	2·09	3·79
Soluble albuminoids	0·93	0·79	1·23	1·42
	3·06	4·61	7·41	9·14

		Cold.	2 Hours.	4 Hours.	8 Hours.
Second Households. No. 1.		1·36	2·83	4·09	5·39
		0·89	2·34	2·40	3·80
		0·76	0·65	1·29	2·12
		3·01	5·82	7·78	11·81
Second Households. No. 2.		1·57	6·01	6·01	7·59
		1·04	0·84	1·21	0·67
		1·05	1·45	1·31	1·89
		3·66	8·30	8·53	10·15
Brown meal.		trace.	3·41	3·93	4·99
		2·70	0·95	2·09	2·89
		0·62	0·70	1·39	1·33
		3·32	5·06	7·41	9·21

Inferior Flour.	4 Hours.	8 Hours.	With Lime. 4 Hours.	With Lime. 8 Hours.	High Dried. 4 Hours.	High Dried. 8 Hours.
Maltose	6·82	11·14	6·82	8·20	4·44	4·44
Dextrin	0·43	1·23	0·11	2·19	1·78	2·91
Soluble albuminoids	3·19	3·74	3·34	3·34	2·48	3·29
	10·49	16·11	10·27	13·69	8·70	10·64

You will find the varieties taken consist of Vienna whites, the best whites, the best households, second households, and brown meal. They have been digested in cold water for a few minutes; then afterwards they have been kept up to a temperature of 100° Fahr. for 2, 4, and 8 hours. If you look at the figures you will find, with these different kinds of flours, very remarkable differences are brought about by simply keeping the flours in a moist condition, at 100° Fahr. For these respective times, in the case of the Vienna whites, we find at the end of two hours, 5·16 is the amount of total soluble matters; at the end of 4 hours, 7·2; at the end of 8 hours, 9·73, and so on. I will not go through the whole list. The point I wish to call your attention to is this. Here and there you will find some slight discrepancies, partly due, it may be, to slight errors of analysis, partly to the difference of manipulation, and partly also to some difference in the nature of the soluble albuminoids, but still, even allowing for all that, you will find that there is a considerable agreement. The longer you carry on this operation, the more you degrade, not merely the albuminoids, but the more also you degrade the starch down to the condition of maltose and dextrin. That process we call a hydration process. In the case of the second households, an inferior variety, we find, at the end of 8 hours for example, the amount of the soluble albuminoid matter has increased to 1·89. In the case of No. 1, it has amounted to 2·12, giving us a total of 11·13 soluble matters.

We shall find afterwards the importance of these investigations when we come to consider the baker's process, when he has to submit, not flours very high in quality, but flours of inferior quality, to a long process of panification.

I pass on now to a very important matter, namely, the effect of kiln-drying. A few minutes ago I called your attention to the ways that man has of overcoming the marvellous activity of the albuminoids, in degrading the molecular structure of animal or vegetable substances. The same occurs of course in wheat as in other things. Now, the influence of the kiln-drying I take to be this. In the first place, if you consider the corn that has not been thoroughly well matured in consequence of the insufficient amount of heat in the last stage of the ripening process, I think you will agree with me that kiln-drying must do much good in ripening, as it were, the albuminoids. In the case of wheat which has been fairly well matured, and yet somewhat injured on account of unfavourable harvest weather, we shall find also that the removal of moisture must tend to lessen the peculiar property of these albuminoids to become, in the presence of water, more and more soluble in their nature; and in addition to that, evidently it is of the highest importance that heat shall be given to the grain just as it is ripening—I mean at the end of the process. I am not speaking now of the earlier part of the process, but rather of the last portion of the maturation of the grain. Unfortunately, in a country like ours, we cannot always—indeed we very rarely—get such very excellent conditions as some of our foreign competitors have, and the result is that, every now and then, such as the harvest we have just passed through, we have conditions that are wholly unfavourable in giving the kind of wheat we want. We obtain a large ratio of nitrogen, and also a large ratio of the soluble albuminoids to the insoluble. In other words, we obtain what the baker would call a poor weak flour; weak in gluten—rich enough in total nitrogen, but weak in the important character of nitrogen compounds that he requires for his purpose.

Following the previous table, we have the results of a flour of inferior character which has been also submitted to this infusion process, or, as the brewer would call it, the mashing process—the action of moisture and heat for a certain time; in the first place, four hours, and then afterwards eight hours. I will not read all the details, but simply give you the totals in each case. The amount of matter dissolved at the end of four hours was 10·49 per cent. Indeed, it would have been more, had I employed a more accurate method than the one I have employed for the determination of the soluble albuminoid bodies, but the determination of the amount of albumen in infusions is very laborious, and, therefore, I have availed myself of the very ingenious and very valuable method known as Wanklyn's method for determining the albumen. This process does not give us the true totals, but merely gives relative results, so that the numbers are relatively correct, although, absolutely, they are rather too low. Still, 10·49 may be taken as the amount of soluble matter in every 100 parts. In the case of 8 hours we have no less than 16 parts out of 100 become soluble, and you will see for yourselves what this soluble mass is composed of. While we are considering this table, I may as well call your attention to the next point. Many practical men may have heard of the use of lime in preventing too great a solution of the soluble albuminoids from the cereals. Now, in brewing, it is exceedingly important to have lime salts, especially carbonate of lime, and also to some extent sulphate of lime and sulphate of magnesia, in the water, to prevent too great solution of the albuminoid matters. Ladies who are present will understand this better, perhaps, if I give an illustration of the nature of hard water compared with soft, by referring to the ordinary method of boiling peas. Where you have peas of, what one would call, a certain age, it would be most injurious to harden the water by the addition of a salt of lime, gypsum, or anything of that kind. Under

these circumstances you require, in order to have the peas soft and tender, to use a soft water; whereas, were you boil young peas in very soft water, the liquid is very highly coloured, due to the solution of the albuminoid called legumin. Now the addition here—see table—was simply of a little ordinary powdered chalk, not caustic lime, but the ordinary carbonate of lime, and therefore we find not much action at the end of four hours; but at the end of eight hours, instead of having 16 parts to the hundred made soluble, we have only 13·6. Now, I come to the interesting part of the table. It was done in order to illustrate the action of kiln-drying; but to have brought this before an audience like this, consisting of a great many practical millers and bakers, it would have been necessary to have given a very much larger series, in order to have illustrated the benefit to be derived from kiln-drying, than I have here. I merely made these experiments for the purpose of my argument, to show the action of a com-, paratively low temperature—about 14 0° Fahr. carried on for some six hours. It was a slow drying action, and at the same time, a slow heating one. We find now, in looking at the result, after the corn, or rather the flour, had been submitted to that action, there is a very marked effect. Upon mashing the flour with water in the same way as the others, with the same quantity of water, and the same quantity of flour, and at the same temperature, we find that in four hours, instead of 10·49, we have 8·7 only dissolved. But there is a still more marked decrease found when we submit that for eight hours to the same action; then instead of having 16·11, as we had in the first case after eight hours, we have now only 10·64. Now 10·64, as the total amount of soluble matter obtained from 100 parts of flour is, as you notice on that list, much lower than any. This method is far more efficacious than the employment of lime, and the difference between 10·64 and 16·1 is very marked.

As regards the question of kiln-drying, it is, of course, no new matter, and all practical men know that there are great advantages to be derived from it, especially in a year like the present, when many barleys are not fit for malting purposes until they are kiln-dried. Again, in such a bad year as we have had, and living, not in Egypt, but in a country that is constantly being flooded, we know perfectly well that no miller could make use of grain until it has been submitted, not merely to the drying action in the stack, but also to some extent to the heating action that goes on in the stack. This is more marked when you act upon corn that has been unfavourably garnered. If you submit that to a good process of kiln-drying, a process where the temperature is not high, say about 100° Fahr., increasing slowly to 140° Fahr., and at the same time submit it to a current of air, taking care that the thickness on the kiln floor is not too great, I feel convinced that, in many cases, our inferior wheats could be made, not into good wheats, perhaps, but they could be made much less inferior than they are now.

Before I pass from this, I will call your attention again to the fact that that drying was not done on the kiln floor, it was done with the actual flour; manifestly, therefore, we see that there must be many cases—I am not speaking of what may be called hard dried wheats, grown under very favourable conditions, but of our ordinary wheats, and especially in unfavourable years—there must be many instances where considerable benefits would be derived from a thorough drying of the flour after it has been made, not merely drying it at a low temperature, but at a temperature from 100° Fahr. to 120° Fahr., with a sufficient current of dry air to carry off the moisture.

I pass now to the next stage in the process of bread-making, that is to say, to the flour-making, or grinding down of the flour. I will not detain you long with reference to the process of milling, for a good many reasons. In the first place, we have not much time, there being so many other matters to be discussed. The second reason is one which, I daresay, practical millers who are present will consider all-sufficient, that is, I am perfectly ignorant of the subject, and, therefore, I think it is better that I should not go at all into the vexed question of high grinding or low grinding, or the use of rollers or disintegrators for the purpose of grinding. I would, therefore, rather pass on to the chemical aspect of the question. What is it that we theoretically conceive to be desirable to obtain in the process of converting grain into the flour that is required for the bread-making? Well, I think, in the first place, that no system of milling—whether it be a new method, or with stones, as has been the immemorial custom, and still is the chief method of grinding—can be perfect, unlesss the germ of the corn has been removed, and for this reason, although the germ bears a comparatively small ratio to the total weight of the corn, still it is an important factor. It contains very active albuminoid ferments, and, therefore, if that germ be ground up with the remainder of the flour, it must, to that extent, injure the value of the flour for bread-making purposes.

The next point that occurs to me as a chemist that should be attainable in any good system of milling, is the thorough removal of the bran; not even the slightest quantity of bran should be allowed to remain in the flour when prepared, and for the reason I pointed out to you that there is a soluble albuminoid ferment called cerealin. This is a very active diastasic body. An infusion of cerealin or an infusion of ordinary bran would give you a quantity of soluble ferments that will rapidly attack the starch cells, and in the presence of water hydrate the starch into maltose and dextrin, giving a large quantity of dextrin. That is another reason why I consider that no system of milling is perfect, whether it be done by stones, or whether it be done by rollers or disintegrators, if it does not fulfil these two conditions, the removal of the germ and the removal of the bran.

I know that I am here treading upon very tender ground; not so much in regard to practical millers, they, perhaps, will not be so adverse to me, but I am about to criticise views that have been adopted by some scientific men, and followed by physicians, namely, the great value and importance of the bran. I admit, of course, that bran amounts to about one-fifth of the total corn, and, therefore, the rejection of so much bran would, on a hasty view, seem to be a serious loss. It is true that,

though there is much useless woody fibre, there is also some valuable albuminoid bodies, and, further, that there is a larger proportion of phosphoric acid and potash in the bran than is found in the ash of the rest of the berry. We may admit this, and yet decline to fall into the error made by some scientific writers and by physicians, who have looked solely to the results of chemical analysis and have overlooked the important question of the digestibility of the hard, horny substance known as bran. We know that, if bran be introduced into the flour in large flakes, it acts as an irritant, producing well-known effects; now this powerful laxative action—though it may be in some cases of advantage to persons suffering from sedentary lives, and therefore preferable to aperient medicines—is not what the world at large desires. I may be answered that the bran need not thus be used, and that it should be ground to as fine a powder as the finest flour, and, therefore, there will remain no irritant particles. This view has been taken of a vexed question by many anxious to save the assumed high food value of bran, ignoring that, in so doing, they are reducing the value of wheaten flour for the purpose of bread-making. They might equally recommend that oatmeal or barley-meal should be mixed with flour intended for the manufacture of fermented bread. In grinding down the bran of wheat along with the husk of the corn, you have introduced into the flour an active albuminoid ferment; and so soon as you take such flour containing the whole of the bran ground down to a very fine condition, then, in the process of panification or bread-making, it imparts the peculiar power which soluble albuminoids have of rapidly converting the starch molecules into less simple ones. You have a large quantity of maltose sugar formed and dextrin, and these in the oven give considerable colour. Not merely do they give colour, but they produce another somewhat injurious action, which is, that it is more difficult to obtain, with a thorough admixture of impalpable bran, a light bread. The bread is not only high-coloured, but it is also more or less sodden, and this gives considerable trouble to the baker to avoid, even partially.

As regards the importance of the constituents of bran, I say that the analyst, and the physician who makes use of the analyst as his supporter, in bringing before us the importance of brown bread as compared with white, and who assert that, in rejecting the bran, we are guilty of a serious waste of flesh-forming and bone-forming material, should not take a mere chemical analysis as all sufficient to establish their point. At our first meeting, you will remember, there was on the walls of the room a tabulated statement showing the amount of starch, dextrin, soluble and insoluble albuminoids, fatty substances, woody fibre, mineral matter, and so on, found in various vegetable substances. The table was one of a series used by me in my lectures on agricultural chemistry at University College, and the object of the table was to show, from an analyst's point of view, the comparative merits of various substances for feeding purposes. Now, on this test, we found hay to be of high value as food, and even oat straw to be of considerable value, as, indeed, every farmer knows from experience. Still more valuable than these in heat-giving, and especially in flesh-forming materials, were linseed cake, rape cake, and decorticated cotton cakes. Now those who hold, from mere chemical analysis, that bran is of such high value as a food material that its omission from flour should meet with grave censure, should, from a similar analytical standpoint, urge us to eat hay, oat-straw, linseed, and cotton cakes. Doubtless these substances are of high value as food for cattle, because the herbivoræ can digest and utilise them with ease; not so man, who would starve in a field where a cow or a sheep would fatten. As with hay and linseed cake, so with bran. I hold that the best mode of digesting such food substances is, first of all, by the aid of our hoofed friends, to convert them into milk and cheese, or bacon, beef, and mutton.

The admixture of finely ground bran is detrimental to the fermentation process of bread-making, and this admixture of an active albuminoid ferment, the cerealin of bran, reduces high class wheats, from a fermentation point of view, to inferior wheats. Those who still attach such high importance to bran must, therefore, use the Dauglish carbonic acid method, or muriatic acid and bicarbonate soda, in order to avoid the injurious action of the soluble albuminoids. Later in the course, I shall propose a plan by which inferior flours may be used in the common bread-making process without undergoing degradation, and I will point out how "whole meal" may also be so utilised without injury to the character of the bread. Though I am not a believer in the great merits of the vastly overrated bran, the suggestions I shall have to make will enable those who think so highly of it as a food material, to obtain it in their loaf made by the fermentation process, without being driven to use the loaf of the artificial carbonic acid processes.

I now pass to another matter of considerable interest to millers, that is, the admixture of wheats. Small millers in certain parts of the country, especially in olden times, were not content—but they were compelled—to take the produce of their immediate neighbourhood, but those living in the present age have to compete with people who are making flour in Hungary, the United States, and elsewhere, to invade our markets with, and have to consider the important problem of so utilising our wheats, such as it may please God to give us from year to year, that although in the long run they may be inferior from some points of view to foreign wheats, yet they are fortunately usually so rich in some other qualities, that we can, by judicious admixture, obtain the flour requisite for a high class of bread; and even though we be visited with an unfavourable harvest, yet by judicious management—as for instance, by kiln-drying, and by judicious admixture of foreign wheats—we can, to a considerable extent, remedy the evils from which we are suffering. Not that we shall be able to make them equal to foreign flours for fancy purposes, but we shall be able to make them good useful flours for ordinary household bread. The object, then, of the miller in this admixture of wheats—and in some cases, I understand that even as many as ten or twelve varieties may go into one flour—is to balance the soluble and insoluble albuminoids, so that he shall not have too great a quantity of soluble albuminoids, which our wheats are usually so rich in. Then, while he is looking for a foreign wheat

that will fulfil the conditions of increasing his ratio of insoluble albuminoids to soluble, he must at the same time see that he does not reduce his starch too much. In this way—I was going to say he looks at Péligot's table, but of course he does not do that—he consults his own experience ; but if we look at the table on the wall, we shall find that he will be influenced by these considerations. If he has an English wheat tolerably rich in starch, but yet, unfortunately, containing too much soluble albuminoids, he would look out for some such wheat as the Taganrogg, some of the Hungarians, or some of the Egyptians. One of these Egyptians you see has 19 per cent. of insoluble and 1 per cent. of soluble albuminoids ; and thus, by mixing these with some of the very beautiful wheats grown in the centre and south of Spain, and in some parts of the United States, he will find that he gets wheats that are very rich in starch, but not rich in gluten, and at the same time not very rich in the soluble albuminoids. He is able, by a judicious mixture of the various wheats, so to reduce the ratio of soluble albuminoids as to produce the desired result, and yet obtain a high ratio of starch.

The miller has various ways of testing wheats. One method is to judge from the appearance, the weight, and the general character of the corn, the ability to do which well long experience gives him. Perhaps he may grind some, and make bread of it. He also adopts the method of working it with water, so as to obtain the elastic gluten by constantly washing away the starch. Many years ago, a French baker, of considerable ability (M. Bolland), took this gluten, and, after thoroughly washing it, put it inside a copper tube, graduated to scale, and then placed it in the oven. The importance of the gluten is that, being an elastic material, it entangles the carbonic acid, and rises as the gas expands, so as to form a well piled loaf. He not only weighed the crude gluten after it had been heated in the oven, but he also measured the amount of expansion of the gluten in the tube. There have been, in addition to this, many other methods employed by which, in addition to the experience of the eye, the hand, and so on, the miller has been able to judge of the quality of the wheat; and it is wonderful the amount of ability with which men can deal with these matters, even without the aid of apparatus or chemicals. So far as I know, most methods which have been recommended refer to the quantity of resisting gluten left after kneading with water. I would suggest the following as a useful method of examining flour, though I am not in a position at the present moment to recommend it strongly, because I have not had sufficient experience of it. We do not want merely to consider the amount of gluten—that is certainly a most important factor, because the greater the quantity of that the stronger the flour is—but we also wish—it may be as a subsidiary factor—to know the amount of soluble matters formed in the mashing or infusion process, the mixing with water, and keeping at a certain temperature for a certain time. We want to know, not merely the amount of gluten we can obtain, but also the amount of soluble albuminoids, maltose, and dextrin, that are formed. Now, I have here a series of test tubes properly labelled, and they refer to various qualities of flour—Vienna whites, best whites, best households, second households, and so on, and the process is as follows:—One ounce of flour is weighed out and mixed with four ounces of cold water. This is allowed to digest for one hour. Then it is filtered through a piece of filter paper into one of these test tubes, which cost about 8d. or 9d. a dozen. They can be marked in two places, at the half ounce and the one ounce. The first portion of the filtrate would be thick, and that you can throw away, but the second portion will be clear. If you were examining six kinds of flour, you would have six test tubes, into which you would filter the respective infusions.

According to Péligot's tables, and also according to the work done for these lectures by Mr. Brown, you will see that we get a rough idea—perhaps I ought not to say a rough, but a fairly good idea of the amount of degradation or hydration that goes on in a certain time from the different flours we take. I prefer, for the purpose of the test, to allow it to stand in the cold, because we want to know how much of the soluble albuminoids there are already formed which cold water will dissolve out. Perhaps some of you may prefer to let it stand two or four hours, instead of one, but whatever method you adopt, it will be a method of comparing one sample of flour with another under similar conditions. This being done, you add a little methylated alcohol. This is about 80 per cent. strong of spirit, and costs about five shillings a gallon, being sold without the excise duty. If you add alcohol up to the second mark, and allow it to stand for some little time, you will find, according to the inferiority of the flour, so is the amount of the precipitate, and, according to the superiority of the flour, so does the amount of the precipitate diminish. The more inferior the flour the greater the amount of matter precipitated, and *vice versâ*. At present, it is merely an opaque precipitate, but it will presently settle down to an apparently coherent flocculent precipitate, and then you can judge from the six tubes of the nature and the amount of soluble matter which has been obtained, by simply digesting the respective flours with cold water, either for one or two hours.

It is already past the hour, and I will therefore defer the subject of bread-making to our next meeting.

MISCELLANEOUS.

ARTISAN REPORTS.*

It is not necessary to give a history of the origin of this book, as all the details connected with it have already been related in the *Journal* (see vol. xxvii., p. 753, for Report of Committee), but as no analysis of its contents has yet appeared in these pages, it will perhaps be well to show what the various reporters thought (I.) of the Exhibition and of the workshops they visited, (II.) of the condition of the French workmen as compared with that of the English.

* The Society of Arts Artisan Reports on the Paris Universal Exhibition of 1878. (London: Sampson Low, Marston. Searle, and Rivington, 1879). Price 7s. 6d., or, 5s. 8d. to members of the Society of Arts and exhibitors at the Exhibition.

I.

The long list of subjects discussed by the various reporters is commenced with pottery. Mr. Frank Harris reports on "Pottery" generally, Mr. Aaron Green on "Pottery and Earthenware," Mr. Charles Toft on "Pottery and Porcelain," Mr. J. Randall on "China Painting," and Mr. George Bedford on "Terra Cotta." The productions of the various countries are reviewed, and visits to the Sèvres manufactory are fully described. Mr. Harris believes that our chief competitor and only rival to be feared is France, and Mr. Green expresses his gratification at the honourable position attained by England in the competition, which shows the wonderful progress made since the Exhibition of 1851. Mr Toft considers that the French have one great advantage over us, in that the maiden porcelain clay in France is of a better quality than that obtained in England.

Glass follows pottery. Mr. Joseph Leicester, who reports on "Table and Fancy Glass," expresses the pride he felt, when Sir Philip Cunliffe Owen told the assembled delegates that the productions of British manufactures in glass had produced a profound sensation throughout France, and subsequently, when he made a thorough inspection himself, he came to the conclusion that, although all countries had greatly improved in the manufacture of glass since the last Exhibition, still England stood at the head. Mr. Francis Kirchhoff, who reports on "Stained and Painted Glass," visited several establishments in Paris, and found that there were no material differences in the methods of work adopted as compared with our own.

Mr. William Letheren reports on "Ornamental Ironwork," and remarks that the largest display was found in the Austrian division of the Exhibition. He considers that monotony is a characteristic peculiarity of French work, and that there is a greater variety of design in England. Still, when he compares the artistically wrought iron-work of old artists to be found in many parts of England, he is obliged to come to the conclusion that our art metal-work has lost place and gone behind. He asks the question—Why is this? And finds the answer partly in the fact that the old workman was not overmastered with the feeling "Is this going to pay?" and partly because the good workmen of the present day do not bring their sons up to follow in their footsteps, but choose for them some other calling more genteel than that of a blacksmith.

The report on "Carved Woodwork" is by Mr. Mark Rogers, jun., that on "Wood Carving" by Mr. William H. Howard, and that on "Stone Carving" by Mr. Henry Turner. Mr. Rogers prefers the surface treatment of the Italians to that of the French, but he thinks the English work better than any other in respect to its infinite variety of style, although it is below the French standard in skill. Mr. Howard does not consider that the Italians equal the French in ordinary conventional decoration carving, but that in representing nature in any of its varied forms, especially the human figure, they are always excellent, and sometimes rise to perfection. He does not consider the carving in the British Section equal in artistic merit to that in the French and Italian, but he holds that English carvers were not fairly represented in the Exhibition. Mr. Turner reports that the stone carving in the Exhibition itself is only a very small collection, contained exclusively in the French Section, and that from what he saw he considers that the designing power of the French carvers is obviously in advance of that of the English.

The report on "Machine Tools," or "Machines designed for the construction of other machinery," is by Mr. David Walker, who laments that the show in the British Section was so disproportionally small. He considers that the Continental engineers are still copyists, and that, although the foreigners are well qualified to supply themselves with good substantial and fairly finished tools, it is easy to detect in their work oldness of fashion in design, inferiority of finish, and meaningless ornamentation. "Mechanical Engineering" has three reports devoted to it—one by Mr. J. W. Phillips, another by Mr. James Hopps, and a third by Mr. John Ives. Mr. Phillips thinks the English are essentially mechanical instructors, whilst their neighbours appear to dread having their ideas made public; still the French are making great strides, and are progressing, in an engineering point of view, rapidly. He was greatly struck by the ingenious contrivances, exhibiting much original thought, in the American Section. Mr. Hopps was disappointed with his visits to the factories, as he had expected to see something new, but found no fresh method of working and few tools worth being introduced into England. Mr. Ives did not find that novelty of construction of design in engineering was a particular feature of the Exhibition, and although he found much to praise in the foreign sections, he considers that our designs are more simple, and our workmanship more than equal to that of any other country.

Mr. J. B. Grant, who reports on "Agricultural Implements and Machines," points out that "the exhibits of implements from the various countries at the Exhibition do not, as a rule, fully represent the state of cultivation in those countries. Many articles are exhibited as being purely national, without any pretence to their being the best of their kind used in the country." He considers that the waste of human energy caused by the small holdings in France prevents improvement in agricultural implements, and that the best French machines are at least 10 years behind those of the same class of English or American make. England, he thinks, has no rival to fear in this branch of international competition."

The two reporters on "Horticulture" divided the work between them. Mr. J. Simpson took "Fruit and Vegetables" as his portion, and Mr. George Stanton, "Flower and Ornamental Gardening." The former was especially struck with the examples of espalier and well-trained trees, consisting of apples, pears, peaches, plums, and cherries, which showed that French cultivators are able to do anything they wish with their trees. He is not, however, prepared to say that such labour is well spent. He visited the vineyards of Thomery, and strongly recommends the systematic cultivation of the grape in England. "The essentials in such an enterprise would be a warm and sheltered situation, exposed to the south, a good and not too heavy or deep soil, and, lastly, a methodical and appropriate system of culture thoroughly carried out." The horticultural section of the Exhibition was divided into permanent and fortnightly exhibitions, the former consisting of trees, shrubs, and glass houses, the latter of collections of tender plants, flowers, fruits, and vegetables. Almost all the space not occupied by building was devoted to horticulture in some of its forms, making a perfect garden of the grounds, "where," says Mr. Stanton, "no corner could be found without having some interest attached to it." This reporter, however, saw no examples of carpet gardening which could be compared with those in the London parks. He considers that the Americans excel in garden tools, which are light, strong, and pleasant to handle.

Mr. George M. Berry reports on "Bricklaying;" Mr. William Pyle on "Stone and Machinery used in Stone Work;" Mr. M. Curley on "Plaster Work;" and Mr. E. E. Whitehead on "Cement-crushing Machinery." Mr. Berry found much sameness, both of design and execution, in the French brickwork, and but little of the artistic work and careful execution common in England. He speaks very highly of the specimens shown by Holland and Belgium. Mr. Pyle saw only two stone-working machines that would be at all useful for general building purposes, and these were both exhibited by English firms. There was a granite working machine by a Belgian house, and several machines for rock-boring purposes, suitable for quarrying and

tunnelling. He noticed generally among the French masons a scarcity of labour-saving machinery in use. Mr. Curley saw little to praise in the plain plastering in Paris, and considers the tools used as clumsy in the extreme, ill-shaped and heavy, but the ornamental plastering he found "everywhere introduced with consummate taste, with just proportion, and in good keeping," Mr. Whitehead thought there was much to admire among the machinery, in the production of which each nation seemed to vie with the rest.

Four Reports are devoted to carpentry, consisting of "Joinery," by Mr. W. Hodgson; "Furniture," by Mr. T. Paterson; "Cabinet-work," by Mr. H. R. Paul; "Cabinet-making," by Mr. J. Fraser. Mr. Hodgson remarks on the timber houses of the different nations, and has a special word of praise for the Swiss and Belgian joinery, but he considers that the elaborate specimens of handicraft in the British Section "are worked out with a beautiful finish of detail, which is not surpassed, if equalled, by the work of any nation in the world." Mr. Paterson notices the re-introduction of painting as a method of decoration for furniture, but besides this he did not find any new processes or application of new material. He describes the French show of furniture of the richest kind as magnificent, but he found more signs of life and energy in the English Section. In fact, he says, "the most remarkable thing one has to notice is the very great advance which has been accomplished by English furniture makers in the goodness of the design and in the ornamentation of the work which they exhibit, as compared with that of the other nationalities that contribute to the Exhibition." Much of this advance he attributes to the influence of Mr. Morris. Mr. Paul is of the same opinion as the last writer, and thinks that, for the first time, Englishmen have distanced their rivals. Still, although we have advanced apace we have much to learn. He holds that the contribution from Japan "is so thoroughly original in design, so peculiarly artistic in treatment, and so neat in workmanship, that it is one of the most pleasing and interesting displays in the building." Mr. Fraser writes as a workman from Ireland, and laments that there was not a single exhibit of furniture from Dublin. Speaking as a cabinet-maker, he affirms that English furniture in the Exhibition stood before that of any other country.

Two reporters—Mr. Henry Ganney and Mr. B. W. Warwick—took the subject of "Watch and Clock Making." Mr. Ganney considers the English contributions of horological mechanism, with one exception, to have been very poor. A large number of the clocks and watches were the work of the French and Swiss workmen with London names and trade-marks. He notices the enormous strides made by the manufacturers in France and America in the last twenty years, a period during which the English trade has remained stationary. The Exhibition confirmed a lesson he had learned before, viz., "The horological manufactures of England require reorganising by the large employment of capital and machinery in every department." Mr. Warwick speaks more favourably of the English contributions, but he also thinks that the foreign manufactures are more in harmony with the conditions of the age, and that "it remains for the system of manufacture in England to conform to the demands of surrounding conditions, or in the struggle of competition to suffer the natural consequence."

Mr. Edward Kirchhoff, who reports on "Jewelry," considers that the French excelled in this department, and that the British jewelry was badly represented. The goldsmiths' work from England, however, he thinks was equal, if not superior, to that of most countries.

"Optical Instruments" are treated of by Mr. M. Lambert, who does not rank the show in his department very highly. He did not find any first-rate astronomical telescopes, as the "exhibitors seemed to have turned their attention to the production of instruments which were suitable for amateurs, and which could be sold at a low price." In comparing the work of the Englishman with that of the Frenchman, he prefered the former, as he considers that the instruments made by the latter are too light to be durable, or to have the steadiness required for instruments of precision. At the same time he thinks that "by a judicious combination of the two systems, instruments might be made, possessing the required stability and an elegant appearance, for something less than the usual cost in this country."

Mr. William Bright reports on "Printing," and Mr. Peter Lowson on "Printing Machinery." Both reporters agree that the exhibition of machinery was by no means striking. Mr. Bright describes his visits to some of the chief Parisian printing offices.

"Machinery for Spinning and for Manufacturing Woollen and Cotton Fabrics" are reported upon by Mr. John J. Heywood. The reporter is of opinion that England maintains its supremacy in every branch of machinery for textile manufacture, and that France was the only other country that made any important display. However, he writes, "it would seem, from the indications afforded by this Exhibition, that we have much to fear from Russian rivalry in textile manufactures. The Russians are making rapid strides, and will come very near us in the cost of production, and in the quality of both iron and textile productions."

The report on the "Manufacture of Poplins," by Mr. William Sullivan, deals also with other silken materials. The reporter considers that Dublin sustained its high reputation by the manufacture of the only genuine poplin, the materials other than Irish being of a much inferior character.

M. J. A. Hancock, who reports on "Saddlery and Harness," has come to the conclusion that English leather is by far the cheapest and the best, and he considers that his opinion is confirmed by the fact that two of the largest saddlers and light harness makers in Paris have found it cheaper to get the whole of theirs from England, and to pay the 10 per cent. duty than to buy the leather in France. After England, France may be considered as the next best among the exhibitors. Mr. Hancock praises the harness from the United States and Canada, but regrets that England was not better represented. He devotes special attention to the various appliances and machinery for saving labour, and hopes to see a demand for more decoration in English leather work, which he feels confident could be furnished without any sacrifice of its honest substantial character.

Mr. John W. Smith, who reports on "Shoemaking," says that the Americans were much better represented than the English. When comparing English and French work, he considers that the latter are superior to the former in respect to the "uppers," but that the English workman succeeds best in the "bottoming" department, both in machine-sewn and hand-sewn goods.

"The display of work," writes Mr. D. Connolly, the reporter on "Caoutchouc," "in both the British and foreign sections in this trade was exceedingly meagre, considering its importance and the great number of manufacturers who are engaged in it in this and other countries." This may be accounted for by the limited space accorded to the manufacture. Mr. Connolly found that the heavy machinery was mostly English, partly American, and the remainder French, but that the lighter class of machines were principally of French make.

The volume closes with the report on "Mining Products and Apparatus," by Mr. C. Beringer, and that on "Iron and Steel Manufacture," by Mr. James Logan. Mr. Beringer describes the mining products exhibited, and arranges them under the various countries in order

to illustrate the condition of their mineral wealth. Mr. Logan remarks that, taking it for granted that England has for a century far outstripped every other competitor in iron and steel trades, we may "assume that this pre-eminence has arisen more from our natural resources that from our natural abilities." He holds that foreign competition is a very real danger, but that we have the means of averting it in our hands, at least for some time to come.

The second division of the subject, which relates to the artisans' opinions on the condition of the French workmen, will be printed in the next week's number of the *Journal*.

MEETINGS OF THE SOCIETY

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 14.—"Modern Autographic Printing Processes." By THOMAS BOLAS, F.C.S. JAMES GLAISHER, F.R.S., will preside.

JANUARY 21.—"Domestic Poisons." By HENRY CARR. JOHN SIMON, C.B., F.R.S., will preside.

JANUARY 28.—"The Future of Epping Forest." By WILLIAM PAUL, F.L.S.

FEBRUARY 4.—"Trade and Commerce with Siberia, *viâ* the Kara Sea." By HENRY SEEBOHM.

FEBRUARY 11.—"A New Metallic Compound and its Application to Industrial and Artistic Purposes." By GRANVILLE COLE, Ph.D.

FEBRUARY 18.—"The Euphrates Valley Railway." By W. P. ANDREW.

FEBRUARY 25.—"The Art of the Silversmith." By W. HERBERT SINGER.

MARCH 3.—"The History of Musical Pitch." By ALEXANDER J. ELLIS, F.R.S.

MARCH 10.—"Recent Advances in the Production of Lambeth Art Pottery." By JOHN SPARKES.

MARCH 17.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

APRIL 7.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday Evenings, at eight o'clock:—

JANUARY 22.—"A Lecture on Technical Physics." By JOHN PERRY, late Professor of Engineering, Japan.

FEBRUARY 12.—"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.

APRIL 8.—"On Recent Improvements in Benzine Colours." By H. J. FRISWELL, F.C.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

JANUARY 30.—"Herat." By Colonel G. B. Malleson, C.S.I. ADMIRAL SELWYN will preside.

FEBRUARY 20.—

MARCH 5.—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"Agriculture in India." By W. ROBERTSON, Superintendent of the Government Farm, Madras.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 3.—"Social and Commercial Prospects in the Transvaal." By the Rev. G. BLENCOWE (late of the Transvaal and Natal). Sir THEOPHILUS SHEPSTONE, K.C.M.G., will preside.

FEBRUARY 24.—"Colonial Finance." By WILLIAM FORSTER, of New South Wales.

MARCH 16.—"Iceland and its Resources." By C. G. W. LOCK.

APRIL 6.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

APRIL 27—"Art in Japan." By C. PFOUNDES. Sir RUTHERFORD ALCOCK, K.C.B., will preside.

CANTOR LECTURES.

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S., will be delivered on Mondays, February 2, 9, 17, 23; March 1, 8.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 12TH...Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. William Simpson, "Buddhist Architecture in Jellalabad Valley."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Bentley, "Epiphytes and Parasites."

TUESDAY, JAN. 13TH...Metropolitan Scientific Association, 13, Blomfield-street, E.C., 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. A. Schäfer, "Physiology of Muscle." (Lecture I.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Inaugural Address, by the President, Mr. W. H. Barlow.
Photographic, 5A, Pall-mall East, S.W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. Alfred Simson, "Notes on the Jivaros." 2. "The Canelos Indians." 3. Dr. Hack Tuke, "The Cagots."
Royal Horticultural, South Kensington, S.W., 1 p.m.

WEDNESDAY, JAN. 14TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. T. Bolas, "Modern Autographic Printing Processes."
Public Analysts, 79, Great Tower-street, E.C. 1. Annual Address by the President. 2. Mr. G. W. Wigner and Prof. Church, "The Analysis of Two Samples of Butter several hundred years old." 3. Mr. J. Carter Bell, The Composition of Unfermented Wines of Commerce." 4. Mr. W. M. Hamlet, "The Estimation of Fat in Milk."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m.
Royal Literary Fund, 10, John-st., Adelphi, W.C., 3 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m. Annual Meeting.

THURSDAY, JAN. 15TH...Teachers' Association (At the HOUSE OF THE SOCIETY OF ARTS). Annual Conference.
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. M. Brewer, "Remarks on the Birds and Mammals introduced into New Zealand." 2. Mr. J. G. Baker, "Synopsis of *Alomeæ* and *Yuccoideæ*."
Chemical, Burlington-house, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. F. Harrison, "A Course of Reading in History."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. H. Statham, "Modern Architecture since the Renaissance." (Lecture I.)
Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Mr. Henry H. Howorth, "The Early History of Sweden." 2. Rev. J. G. Fleay, "The Known Lists of Actors, from the Opening of London Theatres in 1577 to their Closing in 1642, as connected with the History and Literature of England." 3. Rev. Charles Rogers, "Further Historical Notes on the Abbey of Cupar."
Numismatic, 4, St. Martin's-place, W., 7 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

FRIDAY, JAN. 16TH.—Teachers' Association (At the HOUSE OF THE SOCIETY OF ARTS). Annual Conference.
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Professor Dewar, "Studies on the Electric Arc."
Philological, University College, W.C., 8 p.m. Dr. J. A. H. Murray, "A Dictionary Evening."

SATURDAY, JAN. 17TH.—Royal Institution, Albemarle-street, W., 3 p.m. Professor T. Rupert Jones, "Coal." (Lecture I.)

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FRIDAY, JANUARY 16, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The Easter Term commenced on Tuesday, the 13th inst. Private students desiring admission are requested to communicate with the Registrar, National Training School for Music, Kensington-gore, S.W.

INTERNATIONAL CATALOGUES OF PUBLIC LIBRARIES.

It is publicly announced that the Pope intends to publish the catalogues of the Vatican Library, and has named a Commission to consider the best means of carrying out the intention. It can hardly be doubted that when the Vatican publishes its catalogue, the Bibliothéque of Paris, and other European libraries—Berlin, Vienna, Brussels—will follow the example, and so by degrees an International Catalogue, as approved by his Royal Highness the Prince of Wales, the President of the Society of Arts, in due time may be forthcoming. The British Museum has decided to print from time to time catalogues of all future additions to the printed books, and the first instalment it is expected will shortly be issued. How to print a catalogue of the printed books of the past in the form suggested by the Society of Arts, or otherwise, is under consideration, and it may be hoped that the action of the Vatican will hasten the decision of the Trustees and Government.

Copies of the Society's Report on printing the Catalogue of the printed books of the British Museum may still be obtained by Members, of the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF BREAD-MAKING.

By Professor Graham, D.Sc.

LECTURE IV.—DELIVERED DECEMBER 15, 1879.

I have, at last, arrived at that stage of the course which, I fear, many of you must have thought I might have come to before; but, when one considers the very important and somewhat obscure phenomena underlying the baker's art, I think that the careful study of the properties of the different substances entering into the composition of bread, and of the very interesting phenomena connected with the hydration-products formed in the panification process, will be deemed of sufficient importance to justify the time that I have given to this preliminary part of the subject.

I, therefore, proceed this evening to the manufacture of bread, giving you a short outline of the process; but I do not propose to discuss at much length this part of the subject, because we shall have ample matter to consider it, irrespective of the technical details of bread-making. I must preface my brief description of the process by the statement that bakers, in different parts of England, employ different methods in their art, and probably many here present, who are practical men, and who have done me the honour of attending this course, will find in some points—perhaps, not many—that I do not describe the particular method they follow; but, for the purposes of a general audience, I think it will be advisable to take bread-making as known in London, or in the West-end of London, as an illustration of the art generally.

The first part of the process consists in the preparation of what is technically called the "ferment." I ought to say, first of all, that a sack of flour weighs 280 lbs., and that a sack will turn out about 90 to 94 loaves of 4 lbs. each, according to the quality of the flour; so that I shall deal with a sack of flour as the unit of the operation which I shall proceed to describe. Bakers themselves, inasmuch as it is much more convenient to measure water than to weigh flour, are in the habit of speaking not so much of the flour employed as of the water. The first part of the process is the preparation of the ferment. This consists in taking potatoes, about 6 lbs. to 8 lbs. to the sack—some use as much as 12 lbs.—and the potatoes should be, of course, well selected, mealy, not waxy or unripe, and ill-matured. These are well washed, then boiled, in order to burst the cell walls of the potato starch. After they have been boiled thoroughly, they are mixed with additional water, and then put into a fermenting tub, and when the temperature of the water and of the mashed potato has cooled to 85° Fahr., the yeast is added. One quart of brewers' yeast is employed to the sack of flour, and, in addition to this, a pound or two of flour is added

to supply albuminous food to the yeast, and this constitutes the "ferment." Fermentation commences, the soluble starch—the properties of which I have previously described—is affected partly by the direct action of the yeast, and partly by the action set up by the yeast-ferment on the soluble albuminoids in the flour which has been added, and the result is the hydration of the starch and the conversion of the starch into the sugars and dextrin, which I have described so fully. This process goes on for some five hours; it rises during that time, and at about the end of five hours, varying a little with the temperature, the head falls in. The head having fallen in, it is allowed to remain in a quiescent condition for two or three hours, and then the baker proceeds to the next stage, which is the preparation of the "sponge." They call it "stirring the sponge." In the preparation of the sponge, about one-fourth of the total flour—or one-third according to the practice of those bakers who prefer a stiffer sponge—is taken. This is placed in the trough, and the "ferment" is added, along with some more water at 85° Fahr., the whole of the ferment being forced through a sieve, to remove the skins of the potatoes used, and thus the skins do not come into contact with the sponge. The potato, skins and flour on the sieve are well washed by the water here added. The total amount of water used in the ferment and sponge stages being about half of the whole amount used for the sack of flour, this amount is about 60 quarts, varying somewhat with the character of the flour. Thus, up to and including the "sponge," one-fourth—or one-third according to some bakers—of the flour and some 30 to 32 quarts of water have been used.

In the preparation of the sponge, some bakers—not many, but still some who occupy a prominent position in the trade—add a part of the salt, I have been told, about one-half of the total salt; but probably this will depend entirely upon the temperature, as, for example, whether it is winter time or summer. The object of the salt is to check somewhat the activity of the ferment, and I shall presently allude to this matter again, because many bakers do not adopt the plan of adding salt at this particular stage.

The sponge being made, it is allowed to go on fermenting for some time. At the end of about an hour it increases visibly in size, and this increase, due to the production of carbonic acid gas, causes it, at the end of about five hours, to "break." When the mass has risen to its fullest extent, the sponge breaks, owing to the escape of some of the carbonic acid gas, and, having broken and fallen down, it commences to rise again, and in about another hour, varying somewhat according to the temperature at the time, or of the room, the sponge rises again, and breaks again. This is called the second break. So soon as it has broken a second time, the remaining part of the flour—which would be about three-fourths, or two-thirds, according to the practice followed by the baker—and the remainder of the water are added.

We pass thus to the dough. The remainder of the flour having been added, and the remainder of the water, the whole is thoroughly well mixed, and it is at this stage when most bakers add the whole of the salt. Other bakers only use that which remains over after having employed a little at the sponge stage. The total quantity of salt used I find to be about 3 lbs. to the sack, or 48 ounces, which would give about half an ounce of salt to the 4 lb. loaf of bread. This part of the operation of bread-making entails a very great deal of hard manual labour, and it has, therefore, often been proposed that one should introduce machinery, with a view to lessening the amount of mechanical labour. There was exhibited at our last meeting an instrument, the invention of Mr. Pfleiderer, which seems to be a very successful piece of machinery. My business, however, is not to discuss the mechanical advantages of this piece of machinery or that, but rather to confine myself to the chemical phenomena. I did hear an objection to it, that, in order to be a really useful instrument, it would require to have other power than manual, but those of you who are practically interested in the matter must judge of this for yourselves.

The dough having been thoroughly well worked is now left for one hour, in order to rise again. It is then scaled; that is, it is cut and weighed off in proper quantity and made up into loaves. By the time a large batch of bread has been scaled and made up, of course, the previous portions are ready for the oven. They are then put into the oven, and are there heated for about an hour and a half, the temperature of the oven at the time of the introduction of the bread varying from about 400° Fahr. to 450° Fahr. Of course, that is not the temperature of the bread, because the bread contains water, and, therefore, it rises little, if at all, above the ordinary temperature of boiling water.

There are some modifications of this process as just described. First of all, some bakers use the whole of the salt in the stage which is called the preparation of the dough; whereas, as I have pointed out, some use a part of the salt at an earlier stage, namely, in the sponge stage. Again, some use a thicker sponge, some use as much as one-third of the total flour, and others only one-fourth. Again, some employ what is called patent yeast, instead of brewers' yeast. Patent yeast is made by taking an infusion of malt and boiling that with hops, and then, when it is sufficiently cooled, yeast is added, and in that way young active yeast cells are formed. Those who employ patent yeast take, I believe, about 6 lbs. of this patent yeast—in winter 7 lbs.—to the sack of flour. One other point, to which I need only briefly allude, is the preparation of what are called fancy breads, more especially the beautiful rolls and loaves introduced during the last few years to the London public in imitation of the bread made in Vienna, and afterwards in Paris. These fancy breads are fermented, not with the ordinary brewers' yeast, but with German yeast; and the process—as I understand, followed by almost every one—is, to make the "ferment" first. This ferment is made with potatoes, and also with brewers' yeast, as usual, but, in the sponge stage, German yeast is employed, and a considerable quantity, so that the fermentation is very rapid, and thus one obtains very large, light, and porous bread.

I will now briefly consider the chemical changes of the process. In the first place, in the preparation of the ferment, I said that potato, or fruit,

as it is technically termed in the trade, is employed. Now, this is not used for the purpose of adulteration, nor is it used for the purpose of increasing the profit. On the contrary, very often the baker has to give a very much greater price for the starch in the potato than for the starch in flour or in rice, for it would be much cheaper for him to buy cereals for this purpose. His object is this. With the exception of the Maranta arrowroot and the "Tous les mois" arrowroot, potato starch is the largest of the starches, and it readily lends itself to the expansive action which takes place in boiling. On bursting, the granulose matter, the starchy matter of the cells, exudes from the ruptured cell-wall, as I have pointed out to you before; and it is only on the starch after it has been made in this soluble form that the soluble ferments of the yeast can act. Therefore, the baker has found out for himself long before science was able to teach him—I do not know how old the custom is, but certainly long before science could have taught him—the baker found out for himself the advantage of using a small weight of potatoes to develop the fermenting organisms required to do the work of converting a sack of 280lbs. of flour into bread. Now, in 8lbs. of potatoes there is only, at the very outside, one-fifth of its weight of starch, and one-fifth of 8lbs. is but a very small quantity when dealing with 280lbs. of flour; and manifestly, then, this arises from some other reason than a desire to substitute a cheap material for a dearer. Its real value is to enable the baker to obtain an active propagation of the yeast, and to enable him to get a larger quantity of sugars and dextrin formed in a given quantity of time than if he were to employ flour only. I believe, in some cases, bakers also scald a little flour, in order to obtain some soluble starch in that way, in addition to the employment of potato. During the preparation of the ferment, which lasts something like eight hours, there is a continuous action, to which I called your attention at our last meeting, when I showed you, from the analyses of Mr. Henry Brown, that soluble albuminoids, in the presence of moisture at about 100°, and also at 85°, gradually become degraded, less and less complex, and, therefore, more and more mobile; and this action converts soluble starch into those more hydrated products, maltose and dextrin, which I described to you at our second meeting.

The ferment having been much increased by the treatment with the potato and the small quantity of flour employed, the next stage is the preparation of the sponge. Here the baker adds a portion of the flour, either one-third or one-fourth, according to his custom, and, of course, a portion of the water. This is thoroughly intermixed, and so the fermenting action goes on; partly upon the sugars already formed in the first or fermenting stage, and partly also (and to a great extent with inferior flours) upon the albuminoids and starch of the flour added in stirring the sponge.

The third stage is what I will call, chemically, the inactive stage. I do not mean to say that no change goes on, but that, as compared with the very great chemical activity of the fermenting stage, and the powerful fermenting activity of the sponge stage, we may call the dough stage—when it is made thick and firm, and when salt is added in order to check further action—the inert stage, the object now being that there shall be no more degradation of the albuminoids, no more breaking up of the complex starch into simpler molecular groupings. Sufficient of the sugar has been formed to carry on all that is required at this particular stage. The period given for the carrying on of the fermentation is only about an hour, and then the dough is put into the oven in order that the action shall be stopped; but, of course, before it is stopped, the temperature acts on the globules of carbonic acid gas; they expand under the heat, and so they lift the bread, and they are able to lift it on account of the resisting elastic property which the gluten of the wheat possesses.

The first object aimed at by the baker in the process of bread-making, is to get a thoroughly good aeration of the finished bread, so that it shall be light, not heavy, that the air spaces which lighten it shall not be large, but that there shall be a large quantity of smaller air spaces, and to obtain, in other words, a well-piled, well-aerated bread. The next point the baker aims at, is to have as little colour produced, in the panification process and in the oven process, as possible, and his object in endeavouring to obtain as little as possible of coloured products is, doubtless, derived from the fact that inferior flours are pre-eminently prone to give coloured products, and the world at large has come to conclude that high-coloured bread is due, of course, to inferior flour. These are by no means the only objects that the baker has in view, he also desires to obtain a loaf that has a nice aroma, and a sweet—I think they call it a "nutty"—taste on the palate.

The use of salt is a very interesting discovery on the part of the unscientific baker. The baker found out the value of it long ago, and also in this case before there was any science to tell him of it. In a very interesting lecture, delivered some few years ago by Mr. Callard, a baker of well recognised eminence in the trade, it was pointed out that the salt might be compared to the bridle, and the yeast to the whip, that the one was a check on the other, and that by a judicious use of salt at the different stages, one could guide and arrest the fermentation.

I proceed now to a matter which must have arisen in the minds of all of you. What is the cause of fermentation? To what is this production of carbonic acid gas due, and to what is the production of alcohol which is always noticed in the fermentation of bread due? I will not detain you long with a matter which has interested scientific men for many years; but, inasmuch as it is an exceedingly interesting branch of science, I think it well to give you a short account of the various views which have been held upon this question, and to point out to you the knowledge we now possess in regard to it. The first philosophical explanation of alcoholic fermentation was that given by Stahl and Willis. They said that alcoholic fermentation was due to a peculiar motion imparted from the degrading body to a body in its neighbourhood, and the body receiving this peculiar impulse or motion was degraded from a complex structure to structures more and more simple. This idea that a body having a peculiar kind of motion or vibration can communicate to another body in its neighbourhood the same kind of vibration or

motion is certainly not unphilosophical. For example, if we were to take a rod of iron—say, a small poker—and suspend it by a string in the middle of this room, so that the pointed end would be directed to this side of the room, which is the north side, and were then to tap the poker for a short time with a small hammer, or piece of wood even, we should find that the poker becomes possessed of properties which it did not manifest before. Thus, if we were to suspend it in any other room in London, or in England, the pointed end would be directed to the north side of the room when free to swing. The extent to which it would manifest this peculiar property would depend on the amount of tapping, and the conditions observed by the operator, and for a time the poker would retain this peculiar tendency of pointing north and south.

Now, by this peculiar mode of tapping the poker, we set up a number of vibrations, which would, under ordinary circumstances, produce no manifest effect on the poker, but, because we placed the poker at right angles to the diurnal rotation of the earth, then we have those rotations compelled to take a peculiar, and, as we term it, polar arrangements, so that the vibrations circle round the axis of the poker, and the result is that, for some time, that poker acts as a magnetic needle. In much the same way, if I had a large finger-glass, and if I were to strike a particular note on the string of a fiddle, I could compel that glass, supposing I knew its dominant key, also to give forth the same note as the one I had produced from the string of the fiddle. Doubtless, there are many other instances you may, yourselves, think of in support of the idea of Stahl and Willis. This idea was taken up by Liebig and by others, who developed it to a considerable extent. Liebig said that the peculiar kind of motion was an oxidation action, that it was due to the oxidation of complex albuminoids, and by the oxidation of albuminoids he accounted for alcoholic fermentation of saccharine molecules, and for the fact that the sugars, therefore, were broken up into alcohol and carbonic acid, or, at a higher temperature into lactic acid and acetic acid. The views of Stahl and Willis would, at the present day, account for the peculiar action of the hydration of starch, but it certainly does not account for the alcoholic fermentation. While these views were held so recently, strangely enough, in 1680, a Dutchman, Leuwenhoeck, contended that yeast consisted of minute globules. The matter was forgotten, however—for microscopes in those days were not of very great power—until the year 1837, when Cagnard de la Tour, and also Schwann, corroborated by Kützing, distinctly proved that yeast was a cellular organism. But the great workman in this field of investigation has been Pasteur, to whose labours throughout a long period of his life—labours carried out even at the sacrifice, to a great extent, of his health, and certainly to the injury of his sight—we owe the true clue to the nature of alcoholic and many other fermentations. The problem whence come ferments has been, to a great extent, answered by Pasteur. If you take an ordinary grape, well-grown in the south of Europe, you will find a beautiful bloom upon it. That bloom partly consists of minute organisms and dust that has fallen on to the skin of the grape. Now, Pasteur proved that it was this dust adhering to the outside of the grape that set up fermentation in the expressed juice of the grape. I will not detain you by a long account of his work, but I will merely say that, in the first place, he so arranged his experiment that he could take from the inside of the grape a part of the juice without any trace of the dust on the skin coming in contact with it. He found, when that juice was put in small tubes, and in tubes which had been previously heated so that there should be no trace of organised dust existing in them, and with proper means taken to prevent any more dust getting into such a tube, the juice would not ferment. On the other hand, when he took a small portion of the dust of the skin of the grape, and added it to the juice from the interior of the grape, he got vinous fermentation. The juice was converted into wine by alcoholic fermentation. Not only does the grape contain this minute ferment on the skin, but also the dust of the air generally contains the spores of ferments, and ferments themselves, which may produce alcoholic, butyric, ropy, or other kinds of fermentation. Not long ago, in England, it was customary in Dorsetshire to allow the wort made from malt to spontaneously ferment, and, if you go over to Brussels, even at the present day, you will find there beers well known in Belgium under the names of Lambic and Faro, produced by spontaneous fermentation. After the wort has been made it is placed in large tuns, and whatever dust falls from the atmosphere goes into the large hole at the top, and sets up fermentation. The old process of making bread by means of leaven was also a haphazard process of the same kind; that is, you could not predict exactly what kind of organisms would follow. The result is, as you know, that the old leavened bread was certainly by no means a sweet, pleasant bread, and those who have had the misfortune to drink Lambic and Faro must know how sour and bad they are.

I said that the old leaven contains alcoholic organisms. These have been carefully examined by Engel, and he has given them the term *Saccharomyces minor*, because they are smaller than the ordinary beer yeast, called *Saccharomyces cerevisiæ*. These names may seem somewhat long for organisms so small. I am unable to make use of simpler terms, however, without running the danger of confusion. The *Saccharomyces minor*, discovered by Engel in leaven, measures only $\frac{3}{10000}$ th of an inch in diameter. It is an alcoholic organism, and produces spirit and carbonic acid like the ordinary beer yeast; at present, however, we have no knowledge of the ratio of alcohol to gas. Along with these organisms in leaven occur also the common beer yeast, and numerous organisms of disease, producing lactic, acetic, and butyric acids, also the ropy organisms; indeed, left to chance as the leaven process is, we may expect numerous sources of diseased action. Thus, the spontaneous fermentation of bread (and the leaven process is eventually this) as with the Belgian beer, leaves us the sport of chance.

The dust of the air contains organisms of various kinds; thus, in a short time, a piece of moist bread becomes covered with mould; our boots, if put away in a damp place, become covered with mould, and these moulds consist of different organisms,

readily enough distinguished from each other, and to which different names have been given. One is the *Penicillium glaucum*, another *Aspergillus*, and others are different species of *Mucor*. These all convert starch into carbonic acid and water, providing they are growing in the air; but, if you submerge them in a saccharine liquid, they no longer can breathe the oxygen of the atmosphere by which they were able to convert starch into carbonic acid and water; they are deprived of their oxygen, or, at any rate, in a very short time the amount of dissolved air in the saccharine liquid is used up by them, and the result is that they are compelled to obtain their oxygen from the decomposition of the sugar itself. In getting oxygen from the decomposition of the sugar, they convert the remaining portion of it into carbonic acid and alcohol.

The ordinary mother of beer, called by scientific men *Mycoderma cerevisiæ*, the organism that converts beer into carbonic acid and water, if submerged in a fresh solution of barley malt, sets up a slow alcoholic fermentation, with the production of carbonic acid and alcohol. And so with other cell-structures; not only is this the case with organisms such as I am speaking of, but even the cells of sprouted barley, or of sprouted wheat, or the cells of an apple, act in the same way. If you were to take a sample of sprouted barley, and put that into a bottle, after a week you would find, on opening the stopper, a great rush of carbonic acid, with a strong aroma of alcohol, together with some ethers. The same takes place with fruits undergoing spontaneous decomposition. There is a difference, however, between the action of the cells of vegetable organisms and the yeast cells, such as I have called your attention to this evening, in that they are not able to reproduce; they do not increase; on the contrary, they die; and, therefore, the amount of alcoholic fermentation produced by the cells of the sprouted barley, or the cells of fruits, is comparatively limited.

The conditions requisite for the vigorous action of yeast, and the vigorous growth of yeast, are these:—First of all, a certain amount of air is required. I said just now that the organism was compelled to obtain its oxygen from the decomposition of the sugar; but, if you deal with an organism you have submerged under these conditions, the amount of alcohol produced is certainly great compared with the ratio of its weight to the whole weight of the yeast produced, but the amount of work absolutely done is comparatively small; whereas, by the aeration, to some extent, of the liquid, or by the employment of organisms that have previously been exposed to the air, there is a much greater activity.

The next matter of importance for their vigour is the presence of soluble albuminoids. True it is, of course, that Pasteur has shown that the yeast organism is able to attack ammoniacal salts, and to convert them into the protein compounds of its own structure. That is quite correct; but I am speaking rather from the technical point of view, and in that point of view the presence of albuminoids is necessary to active fermentation, whether of beer or bread.

The next essential is the presence of sugars. There must be sugars present in order to undergo decomposition, producing carbonic acid and alcohol, and also to enable the yeast organisms, as they are multiplying, to build up new cell structures by the cellulose formed from the decomposition of the sugar. Nine-tenths of the weight of ordinary yeast, when well dried, consists of albuminoid substances, the other tenth being matters derived from the sugar.

We have seen that dust contains the spores of many organisms, and it becomes necessary, when using ferments—obtained from beer, for example—for the baker that he should see whether the yeast which he has got contains the particular alcoholic organism which he wants, or whether it contains a large number of other organisms that produce acidity—produce, in other words, decomposition of a kind unfavourable to his bread-making process. I have here, on the wall, diagrams representing ordinary English brewers' yeast, the cells of which are circular in character; there is Burton yeast, which is ovoid in character; another one represents ordinary yeast which has remained for a considerable time in a liquid after the fermentation has been completed. Such an exhausted liquid is unfit, of course, for the continual growth and propagation of the organisms, and you will notice that the organisms show distinct granulations; these granulations may be noticed in young active yeast cells, but less distinctly than in the old exhausted cells, in which the protoplasm has been used up in the struggle for existence.

I am afraid some of you at a distance cannot see very distinctly in these diagrams the characteristics of the different organisms, but I have placed on the table more than a dozen preparations, which you can examine with the microscope, showing the different appearance of the organisms which produce healthy alcoholic fermentation, and also those producing the lactic, acetic, butyric, and ropy fermentations.

Under ordinary circumstances, the yeast ferment converts 100 parts of sugar into 51 parts of alcohol and 49 parts of carbonic acid, and 5 parts of glycerine, succinic acid, and other products. The ropy organism converts 100 parts of sugar into 51 parts of a peculiar viscous, gummy body, called mannite, 45 of gum, and 6 of carbonic acid. This ropy organism, then, converts saccharine liquids into a thick, oily, viscous mass, and occasionally it happens with a brewer, in the preparation of beer, that a beer which was previously perfectly bright and limpid, pours out as if it were almost like treacle; and, if such diseased kind of yeast be given to a baker, he must expect a similar kind of unfavourable action on the saccharine matter he has made in his previous panification process.

If you take one of these peculiar organisms of mould, the mucors, and submerge it in a saccharine liquid, it begins to form separate cells, in the way shown on the drawing; ultimately, they break up, and they all act much in the same way, though not quite with the same energy as the ordinary English brewers' yeast. I have not got a representation on the wall of German yeast, but it much resembles the Burton, being ovoid in character. You will see an example under one of the microscopes.

London bakers, I am told, find that yeast from certain breweries is much superior to yeast obtained from others. Indeed, I learn that many of them are obliged to go out of London to the more old-

fashioned breweries in order to get the kind of yeast they require. This is probably due to the fact, that, in the older breweries, a different method of fermentation is carried on; the cleansing system, as it is technically termed, is adopted, and not the skimming system; but, with the skimming system carried on carefully with the microscope, one can obtain as pure yeast as by what is called "cleansing," where the fermentation is begun and carried on in large vessels down to a certain stage, about one-half, and then it is placed in smaller vessels, and there the fermentation is continued by the yeast forcing its way through the bunghole. In Burton, they use a combination of the small vessels, termed unions. Bitter-ale yeast is not so well adapted for bread-making as mild-ale yeast; for this reason, that a large quantity of hop has been employed in the process, and the tannic acid in the hop, together with the oil, are inimical to the activity of the yeast. Consequently, the yeast obtained from very highly-hopped ales is not so well adapted for the baker as that obtained from less hopped ales.

I spoke just now of the patent yeast, and it is somewhat singular to find that hops are always used in its production. Indeed, I have been told by more than one, that, if we were not to use hops in dealing with malt, it would be impossible to get any yeast formed, and that, if we were to add yeast to an infusion of malt prepared without hops, we could not get yeast formed. Of course, this is erroneous. It is not much more than three centuries ago that hops were first introduced into England. Old English ale was not made with hops. The use of hops is to aid the keeping qualities of the yeast, by preventing too rapid decay.

German yeast is very largely used in England now. It is not a yeast which comes up to the surface of the beer, in the same way as ours; on the contrary, it is a yeast which settles to the bottom, and, therefore, that form of fermentation is called "bottom fermentation," whereas ours is called "top fermentation;" but, in their chemical action, there is no essential difference between them. In each case they convert saccharine matter into carbonic acid and alcohol, and in the same ratios. On reference to the Board of Trade returns, I find that in the year 1876 we imported £406,000 worth of yeast from foreign countries; in 1877, £437,000, and in 1878, £468,000; so, apparently, the traffic is slowly increasing. When I tell you that in many parts of England brewers' yeast is a drug, and that there is not sufficient demand for it, it does seem that we ought to find some means of making English top yeast into a useful servant to the baker, instead of wasting it, and having to purchase other yeast from Germany. It is perfectly easy, with English top yeast, to secure, on the one hand, that it shall be a quick-growing, active yeast, like the German; or, on the other hand, that it shall be slow in its action, such as ordinary brewers' yeast.

Good flour and good yeast, in the hands of a good baker, will, of course, give us good bread. But, after all, when the Council of the Society of Arts did me the honour to ask me to give a course of lectures on the chemistry of bread-making, they were not limiting their thoughts to the west-end of London. A Society like ours thinks not merely of the west end of London, but of all England; and we have to consider, as I have more than once pointed out, that we have, unfortunately too often, bad harvests, and, therefore, bad flours. Then, again, there are many bakers in country places, and, perhaps, one need not go so very far away to find those, who certainly require some extra assistance in understanding the very complex phenomena underlying their art. I called your attention to the fact, you will remember, that, in our bad harvests, the peculiarity of our wheats was not that there was any deficiency in the total per-centage of albuminoids, but that there was a less per-centage of the tough, elastic, valuable bread-making gluten; and I then said that something might be done by a partial kiln-drying of the wheat, and by so drying the flour afterwards, that it should not be ready to undergo the degradation due to moisture which often occurs.

In the process of fermentation, which I have briefly described to you, we have seen that, in the sponge stage, a considerable quantity of the flour is left to undergo the degrading action set up by the yeast on the soluble albuminoids already there; manifestly, then, inferior flours should not be submitted to such a panification process, for two reasons. In the first place, there is a want of the proper elastic matter in the bread; secondly, a large amount of colouring matters is obtained in the fermentation. If you will refer to this table of Oudemans showing the action of a high temperature on the albuminoids of wheat,

Composition of Barley and Malt. (*Oudemans.*)

	Barley.	Malt.		
	Air Dried.	Air Dried.	Kiln Dried.	Kiln Dried.
			Pale.	High.
Starch	67·0	58·1	58·6	47·6
Dextrin	5·6	8·0	6·6	10·2
Sugar	0·0	0·5	0·7	0·9
Cellulose	9·6	14·4	10·8	11·5
Albuminous matters	12·1	13·6	10·4	10·5
Fatty matters	2·6	2·2	2·4	2·6
Ash, &c.	3·1	3·2	2·7	2·7
Torrefaction Products	0·0	0·0	7·8	14·0

you will find that, when malt undergoes a kiln-drying action, which is at a temperature certainly lower than that of the oven, there are 7·8 per cent. of torrification products. These are formed, to a great extent, from the destruction of the albuminous matters; they are also partly formed by the action of heat on the saccharine matters. At a still higher temperature in what is called "high dried" malt, we have no less than 14 per cent. of torrification products, but those coloured products are almost entirely due to the action of heat on the degraded forms of albuminoid matters, and on the dextrin and maltose formed. Manifestly, therefore, the inferior wheats should not be submitted to the panification process. That was the conclusion come to some years ago by Dr. Daugleish, and he devised a system by which one may employ inferior wheats by using carbonic acid

made in other ways, and not by the action of the yeast-organism upon the flour. Of course, tastes differ. I do not know how many of you like aerated bread, but personally I do not like it. There is a want, to my taste, of that nice sweet flavour one gets by the fermentation process. Those who like aerated bread have certainly an excellent means of using inferior flours; but, for those who wish to have the peculiar aroma which is brought about by fermentation. the problem presents itself, how shall we have carbonic acid manufactured in the ordinary fermentation process, and yet not obtain the highly coloured products which are formed when we carry on that process with inferior flours?

It seems to me that we can get over the difficulty by not allowing these inferior flours to be submitted to the action of the albuminoids of yeast, and, therefore, that in our preparation of the ferment we should use the best potatoes and the best flour. I did suggest that it was worth while to try the effect of using the sugar called dextrose in conjunction with potato, and one might also suggest that the potato-starch which comes so largely from America and elsewhere, and which can be bought at 21s. per cwt., might be used along with or in place of potatoes. But, in the second stage, I think the important change to make is this: that we should use, for what is called by the baker the sponge stage of the fermentation, where it remains eight hours, a quarter of the flour, and not allow the flour of the sponge to be inferior, so as to undergo this very serious degradation by which an unpleasant form of bread is obtained, and a high colour. It seems to me, that in this stage one ought to use flour made from well-matured wheats, and that when we come to the comparatively inert stage, which only lasts for a short time, and in the presence of a comparatively small ratio of water, that then we should make use of our inferior flours, if we are so unfortunate as to have them. I suggest this as a method by which we may improve, not merely the appearance of the bread, but also its digestibility, because a heavy, sodden bread, is not the kind of bread that lends itself readily to the subsequent stages of fermentation, which I shall have to draw your attention to.

[At the conclusion of the lecture, Professor Graham drew attention to a series of preparations of yeast-organisms and starches, placed under microscopes, kindly lent for the purpose by Mr. Crouch, of 66, Barbican, London. He stated that these powerful microscopes, with an $\frac{1}{8}$th objective, condenser, and other appliances, cost £7 each, and were marvels of excellence and cheapness.]

JUVENILE LECTURES.

RECENT WONDERS OF LIGHT.

By W. H. Preece.

LECTURE II.—DELIVERED 9TH JANUARY, 1880.

I told you the last time we met together that the principal object I had in view in these lectures was not to startle you with new wonders, but to endeavour to train your minds to observation and experiment, and to exercise what is called the scientific application of the imagination. The exercise of this power is a constant source of enjoyment and instruction; in fact, it supplies us with a library that is unwritten and without weight, and enables us at all times to find something to amuse and entertain ourselves.

Every science, of whatever branch, is always based on facts. Last week I showed you a few simple facts in connection with sound. I showed you how sounds, or sonorous vibrations, are conveyed and imparted to the brain. I showed you that a medium was required to carry these vibrations to the ear, and that the medium in the case of sound was the air. There is, first, some thing required to produce the sound; secondly, something to transmit the sound; and thirdly, something to receive the sound and impart it to the brain.

In the same way with light. Light, like sound, is a mere form of vibration; and, again, like sound, it requires some source to set this vibration going—some medium to carry the vibrations from their source to the receiver, and a receiver, viz., that exquisite organ, the human eye. I ought not to say the human eye, because animals and insects have eyes which are still more wonderful than that of man. I ought to have brought the subject of light before you first, because in that wonderful first chapter of Genesis, it is noted that the first thing created was light: "Let there be light; and there was light." But I gave sound the precedence, because I thought that by showing you the simple way in which sound is produced and transmitted, you would more readily gather some notion of similar facts in regard to light. I have said that light is vibration; it is the vibration of that medium that fills all space, called the ether. The process by which a ray of light is received on the eye through the medium of the ether is similar to that by which sounds are received by the ear. But the velocities of the two kinds of vibration are very different. You are all familiar with waves on water. These waves travel about a foot per second. The waves or vibrations of sound, I told you, travel at the rate of 1,100 feet per second. Light travels at the rate of 186,000 miles per second, and we may regard this speed (as I said in my last lecture, when speaking of a thunderstorm) as practically infinite. While the length of a sound wave produced by the voice varies between one foot and seventeen feet, that of light waves varies between the thirty-six thousandth and the sixty thousandth part of an inch The fewest number of vibrations the ear perceives is sixteen per second, but nearly five hundred billions strike the eye. Of course it is impossible to grasp such figures as these with our minds, and it is only by constant thought, research, and ingenuity, that we can form some notion of the infinitely great and the infinitely little. Light, like sound, varies in itself in three ways, in quality, in intensity, and in pitch. The quality of the light is easily shown. We have the soft light, produced by the sun burner in the centre of the ceiling, that produced by the various lamps before you, and you are all familiar with the yellow light of the candle and the red hue of the fire. So all sources of light vary in different modes as regards their quality. Here is a spirit lamp, which I bring alongside this gas-burner, and you see the con-

trast—the blue flame of the lamp and the bright flame of the gas. Light varies in intensity. Here you see the mild light of the spirit lamp, and later I will show you the brilliancy of the light produced by electricity as compared with gas. The softest light is that due to phosphorescence, which is a case of vibration set up in certain bodies by light itself, and is seen sometimes in the sea when a vessel is ploughing through it on warm summer evenings.

Sounds vary in pitch. Notes of music are produced by the different times with which the ear is struck. So in light the pitch depends upon the number of waves striking the eye per second. Light, as you are aware, as we experience it, is white. But this apparently white light is made up of a bundle of other lights, as we see in a rainbow. In order to show you of what a white light is composed, I will ask for the gas to be turned out, and will cause a ray of white light to be thrown from a lamp on to the screen on the wall. There it is. You see the light burning in the lamp, and on the screen you see it as refracted, or passed through a prism of glass. The light, as it passes through the prism, is divided, and its rays are diverted by refrangibility, as it is called; and this refrangibility causes the white light proceeding from the lamp to be decomposed into its constituent parts, which appear on the screen in the different colours you see—red, orange, yellow, green, blue, indigo, and violet. I always remember the order in which these colours appear by repeating the sentence, which I learned from Mr. Stokes, of "memory" renown, "Read over your good book in verse." You will never be at a loss to remember the order of the colours of the rainbow if you will only impress that sentence upon your memory. Having shown you how light can be decomposed, I will now take the reverse process and show you the re-composition of light. Here is a disc, on which the different colours of the rainbow have been painted. By causing this disc to revolve rapidly you will see that the colours, as it were, combine and make up what appears to you as a dull grey or dirty white light. This is the result of the rapid rotation of the disc, and the impression of the different colours painted on it upon the eye. I dare say a good many of you have seen that pretty little light proceeding from a glowworm. Many of you, when at sea, may have noticed a beautiful, brilliant effect when the vessel has been rapidly going through the waves. This is caused by little insects, which give out the effect called phosphorescence. Those who travel abroad may have noticed in America those brilliant things flying about called fireflies. In all these cases light is produced, not by combustion, not by burning, not by the means that we are familiar with in our houses, but by the actual molecular vibrations set up by the action of light itself. The new luminous paint illustrates this. I have several articles which have been coated with this new luminant. Here is a card, which I will expose to the light for a second or two, and now, on turning down the gas, you see that a luminous effect proceeds from the card. Mr. Horne (whose firm are agents for the inventor of the article) will now stand by a screen before you, and we will turn the light on him for a short time. There, now the gas is down, you see his shadow on the screen surrounded by the luminosity. Of course, as he stood between the lamp and the screen, his figure prevented the light from the lamp falling upon the screen; hence his figure or shadow appears dark, surrounded by the space upon which the light had fallen. This curious property has a future before it in various ways. For instance, not very long ago, I was travelling in the Mediterranean, and a poor French soldier, in the middle of the night, thought he would like a bath, and descended into the water; but the force of the waves was too strong for him, and he was instantly carried away. The ship was stopped, and we went searching about for him for four hours, when we gave up the search in despair, and went on our journey. We had proceeded more than a mile or so, when we came across the poor fellow, who was thoroughly exhausted. We picked him up, but he died after a few hours. Now, if we had had a life-buoy on board, coated with this paint, that could have been thrown to the man when in the water, and he would probably have been able to see it, and might have saved himself. I have two buoys here, one painted in the ordinary manner, and the other coated with the patent compound. The gas is now out, and I wave the two buoys backwards and forwards, and you can see only one of the buoys, and that because of the light given out by the paint. Here is a box containing glass tubes, in which various colours have been arranged. You will see that this kind of thing may be useful in a dark place, by producing, as it were, a phantom spectrum. [Other articles were shown, such as surfaces, upon which words, "Danger," "To let," &c., had been marked out, and a few India-rubber balls, covered with the paint, were thrown among, and quickly caught, by the audience. Boxes of matches (given by Messrs. Bryant and May) on the ends of which paint had been placed, so that they were easy to find in the dark, were also distributed. The words, "Wonders of Light," were also shown in the dark on the wall.] While we have the sun to rule us by day, and the moon by night, this new material may be useful to light up the dark spots in our domestic corners.

From the very earliest days man has succeeded in producing light for domestic illumination. Striking two stones together produces light. Wax and tallow were the materials first used in the old time for lighting purposes. It is most remarkable that the means for producing artificial light were rough and uncouth even up to the beginning of this century. The ancients used oil in different forms; and, through the kindness of Sir Phillip Cunliffe Owen, we have for exhibition here samples of lamps used by the Greeks, Romans, and Egyptians. In India the primitive kind of oil lamps are still in use. Lamps, in which olive oil was used, are mentioned in the 25th, 27th, and 37th chapters of Exodus. To those who have visited Rome, one of the most interesting things to be seen is a sculpture on the Arch of Titus, showing the actual seven-branched candlestick that was constructed under the guidance and instruction of Moses.

In conservative Egypt, where we find all the manners and customs of the ancients carried out now as two thousand years ago, there we still find the same means of lighting in use as of yore. Coming to later times, we have the Saxons, and those who read Sir Walter Scott (and I hope every

one in this room has or will), will find in his books many an interesting tale told of the habits of our ancestors, the Saxons. There we learn that they used long wax candles, not only for giving light, but also for telling them the time of day. These candles were marked at certain intervals, representing time, showing how much was consumed in a given time, and so telling the hour of day. More than that, they also had little brass balls fixed into the wax, which, when the wax was melted to a certain point, fell into a brass basin, causing a tinkle, and so announcing the time. Through the kindness of Messrs. Field, I have several specimens of different kinds of candles. Here is one, used at the present day, called King Alfred's candle. It is marked off in spaces, one, two, three, &c.; and, as there are ten spaces, I take it the candle would last ten hours, and so you have a method of keeping time. The candles which King Alfred used were, I am afraid, of a rough manufacture, large in size, and from an artistic point of view, would compare very unfavourably with the elegant samples of the present day now before you, bearing his name. Candles of the present day are sometimes works of art. Here is one in the shape of Cleopatra's needle, a monument in itself, but it has a wick down its centre, and is made to burn, and not to be preserved. The light given by such a candle is a great contrast to that proceeding from a farthing dip. I remember the time when I used to be taken to bed with a farthing dip, or something very like one, with a piece of wire work around it, which was allowed to burn down, and the final smoulder of which gave off an odour of an almost unbearable nastiness, which scarcely left my nostrils by next morning's rising time. Candles have been improved upon since those days, and now, instead of filling our rooms and houses with the horrid smell given off by the old form of farthing dip, we have an excellent light-giving composite candle which is odourless. The candles now-a-days are made of purer matter than the tallow of old. But, even at the present day, in out-of-the-way places, the inns are still lit up by the old impure article. It is often a matter of surprise to me how our friends a hundred years ago lived. The poor of the present day live in brighter, cleaner, and healthier atmospheres than the very richest a hundred years ago. And those who amuse themselves by going to our National Gallery and seeing the pictures of the past, will notice in what a miserable existence our friends of old lived. The Haymarket Theatre used to be lit by candles, and positively, until the year 1842, the lessees were restricted, by the conditions of their tenancy, from burning anything else, although gas came into existence in 1813.

Oil, of course, is a better luminant than candles, but it was only in the last year of the reign of Charles II., in 1684, that oil was introduced into the City of London; and, in those days, there were people opposed to the introduction of any kind of light. Also, when oil was first introduced for street lighting in London, as I have said, it was only allowed to burn from six o'clock in the evening to midnight, from Michaelmas to Lady-day. It was in the bad light and bad smell of bad oil and nasty tallow that our ancestors had to spend their time in their drawing-rooms and theatres. True they had wax, but wax was used but very little, and if you look at Hogarth's picture of "Marriage à la Mode," you will find that about two wax candles were used then to about twenty now. Here is a duplex oil-lamp, giving off a light which many a Roman would have given his fortune for. Here is a moderator lamp, invented by Carcel, in which the oil is pumped up from a reservoir by mechanical action. Here is a Silber lamp, where the wick is supplied with oil by gravitation, and here is the soft steady light produced by a reading lamp.

For those who are interested in lamps, I am able (through the kindness of Messrs. Gardner) to put before you one of these lamps cut in two, which show the mechanical skill that has been brought to bear even in our household lamps. A winding-up clockwork arrangement is set in motion, which pumps up the oil by mechanical action, so that it shall flow gently over the wick, and maintain (as you see in a similar lamp on the table) a brilliant and clear light.

Gas was introduced at the commencement of this century, in 1802. It is a magnificent thing in itself; but one of the greatest advantages of gas has been that it has driven the candlemakers and oil-lamp makers to give us a hundredfold better things than they did before; and so the introduction of electricity, if it does nothing else, will compel our Suggs and gas engineers to produce gas-lighting apparatus as far superior to those of our youth as these ordinary lamps are to the oil lamps of the Greeks.

Murdoch introduced gas in 1802. The manufactory of Boulton and Watt was lighted up by it. Through the kindness of Mr. Sugg, I can show you the manufacture of gas from the commencement to the end.

When I was a boy at school, we often used to be left in the dark. At such times we resorted to the practice (which I daresay every boy among you is familiar with, and which is one of the earliest experiments I ever performed) of making gas with a tobacco pipe. It is called the first retort. I have a pipe here which has been filled with coal, and the open end of the bowl sealed up. After heat has been applied to the bowl, smoke issues from the stem, and on applying a light a flame is produced, which is gas. This pipe was made for smoking, and not for making gas evidently, as it has burst. However, the experiment is very simple, and we will pass on. Experiments are always very uncertain, and so frequently fail, that when a lecturer is successful in two out of three he is happy. There is a tale, that Murdoch and Fairbairn were going to dine somewhere in the neighbourhood of Manchester one night, and they had to cross a dark and dismal moor. So Murdoch made some gas, filled a bladder, and put it under his arm like bagpipes; he then placed a tobacco pipe at the mouth of the bladder which he held tightly, and having applied a light to the tobacco-pipe, started on the journey with a light which took them across the moor. Gas, as you know, is manufactured from coal; and here I have a working model of a complete gas manufactory.

Coal is placed in the retort (which, in reality, is nothing but a better form of my pipe bowl), beneath which there is a flame. The flames heat the retort containing the coal, till the latter goes off in a thick heavy smoke, leaving behind coke.

That smoke is gas, but in its present state it is charged with tar and other matters. It passes into what is called the hydraulic main, in which is placed a water valve that prevents the smoke from going back again, and collects the tar. Through this hydraulic main it proceeds to the condenser, through which water is slowly percolating, which carries away the tarry portion not left behind in the main. The hydraulic main, as I said, retains the tar. Passing through the condenser, the heavy smoke (as those near can see) comes to what are called scrubbers, which contain pieces of coke through which the gas passes, leaving behind it the impurities not taken out in the main or condenser, and from which it issues in an invisible form. It is not clean yet, but it here takes the invisible form. It is still charged with carbonic acid and sulphurets of different forms. It then passes through a purifier, consisting of lime, which extracts the carbonic acid. It then goes through a second purifier, containing oxide of iron, which has the property of extracting the sulphurets, principally sulphide of hydrogen; and now it is thoroughly purified, and passes into the gasholder, from whence it is pressed through the main and issues at the burner, where I have applied a light. If I put a little weight on the holder, you will see how I can add to or diminish the pressure issuing at the burner. It is by pressure of weights on the "holders," that gas is forced along the mains through the streets and into our houses.

Next to the manufacture of gas, we have to consider the mode in which it is burned. On a bar here are fixed various kinds of burners, that have been introduced since the production of gas. There are the Cockspur jet—the first one ever introduced; next, the old "fish-tail"—the fish-tail is made by the gas passing through two little holes in the burner; Webster's; old iron bat's-wing; Wadsworth's; Brönner's; hollow top, which consumes a large quantity of gas, and is, therefore, only used for large spaces; the old iron Argand; the Bray; the Albert; shadowless; and Sugg's London Argand. The Argand takes its name from the inventor. It succeeds in extracting from gas more light than the common form of burner. The Albert is the burner that has given such satisfaction in our streets, offices, and houses. But the large London Argand brought out by Mr. Sugg is the greatest achievement. It has taken the wind out of the sails of some of our electrical people, and shows how the streets of London can be lit up with a light of intense brilliancy. Here is one fitted up complete, and on lighting you see the splendid light produced. It is equal to 200 candles, which, in reality, is a light not far short of some of the electric lights. Here is another new process, called the albo-carbon. It is a little jet of gas, consuming about one foot per hour, and, in the round box above it, there is one of the refuses of the gas manufactory, called napthaline. As the gas comes from the main, or meter, it passes through this napthaline, which increases its brilliancy many times. We have an ordinary burner close by for comparison, and the effect of the napthaline on the one burner is very evident from the increased brilliancy of the light.

Before leaving this point, I ought to show you a fact that every householder should be acquainted with, and that is, that the quantity of light given off by our burners depends very much on the pressure with which it is forced through the jet. Some time last year there was considerable correspondence in the newspapers about gas bills. Many householders found to their astonishment that their gas bills were doubled. This simply arose from the fact that the gas companies, for purposes of their own, increased the pressure through the main; the result was, that, instead of burning gas at about eight-tenths pressure, that force was very much increased. To equalise such variation of pressure, a regulator becomes necessary, either at the meter or burner, which will allow the gas to be consumed without waste. To illustrate this, Mr. Sugg has kindly drawn up the diagram before you. Gas enters with a normal pressure of eight-tenths of an inch. Upon an unregulated burner, such pressure gives a light of 5·9 candles; on a regulated burner, the same quantity would give a light of 15·29 candles. If the pressure be gradually increased on an unregulated burner, the light would be increased, but not in equal proportion; and if we went up to a pressure of 1·7, we should only get a light of 9·1 candles, as compared with the normal pressure, 0·8, with lighting power of 5·9 candles. From this point the proportional increase of light diminishes with the pressure, and if the pressure on the main were increased to two inches, the light power through an unregulated burner would only be 6·6 candles. So that between one and two inches pressure we only gain two-tenths of a candle in lighting power, while the consumption of gas increased from 5·8 to 8·9 feet per hour. In other words, if your gas bill cost £58, it would be increased, under the high pressure, to £89, with scarcely any appreciable increased light. Mr. Sugg's regulator counteracts this extra pressure, and the adoption of it will, in a very great measure, dispel the recent alarm. Let, therefore, those householders who take knowledge of their gas bills, look to their burners and regulators.

All these illuminating effects that I have shown you have been due to flame. What is this flame? I have shown you candles, oil lamps, and gas, and in each case flames are produced. I will show you what a flame is. Here is a single candle where we have combustion going on. Heat is produced, and something burned. Now what is being burned in that candle? If I pass a white clean card through the flame gently, you will see in a very short time that something is deposited. This deposit is carbon in a very fine form. Therefore, to produce flame, there must be something to be burnt, and something to burn it with. Heat and light are identical. The greater the light the greater the heat, and the whole question before us of producing a good light is to produce an intense heat; the best illuminant is dependent on our being able to concentrate the greatest heat on the smallest quantity of matter. To produce flame, matter is required. Here is a pale blue flame, and you see on my blowing matter into it, in the shape of lycopodium, I am able temporarily to enlarge the flame enormously. But I want to increase the heat. Here is a piece of coal. I will just set it burning, and throw upon it a stream of oxygen. This oxygen being pure, intensifies the action of combustion in the coal, which increases the heat produced, and, in consequence, we get a much brighter and more beautiful

light. Here is a common flask which contains oxygen. I put into it a piece of carbon, and you see at once that the oxygen combines with the carbon and produces that violent motion you see going on. The intensely brilliant sparks given off are really beautiful. Here is a piece of magnesium which, on the application of a light, burns with great intensity in the atmosphere, and, consequently, the light given is brilliant and dazzling. As I said, to produce intense light we must have intense heat, and to maintain this intense heat we must call in the aid of electricity. There are many ways of producing electricity. One way is by making wires turn very rapidly in front of a magnet. Here is a little machine that consists of a magnet with a coil of wire inside. By turning the handle I rotate the coil very rapidly, and produce electricity, which appears in the form of heat in the illuminated tube on the table. Also I produce electricity by the consumption of zinc in a battery below, and on joining the two wires attached to that battery to the platinum wire suspended over the table, you will see it illuminated; and on my increasing the power of the battery, the heat in the wire becomes more intense, till, finally, it is severed. That wire is platina-iridium, and you noticed the beautiful soft glow it gave off. That is the principle upon which all electric lamps of the incandescent kind are based. Here is another kind of lamp which is produced by what is called the electric arc. This is the first form in which the electric light was discovered in 1806 by Sir Humphry Davy. Here are two pieces of carbon joined to a battery, and you see, when I hold them near each other, the electric current bridges over the space, forming a brilliant white light, which is called the electric arc. Here is an electric lamp based on the arc principle, the two pieces of carbon being regulated at the proper distance by clockwork; it is called the Serrin lamp. The electric current passing from one carbon to the other carries with it a mass of small particles of carbon, which it raises into an incandescent state, producing heat, and thereby light. This carrying away of particles from one of the carbons, of course, causes it to waste gradually away at a greater rate than the other carbon, and much ingenuity and skill have been brought to bear on the point to produce some means by which the uniform consumption of the carbon can be guaranteed. There are specimens of several kinds of electric lamps of this character on the table, which are very interesting. But one of the most ingenious systems is that of Jablochkoff, which dispenses entirely with complicated machinery in the lamp by making a "candle." This candle consists of two rods of carbon separated by plaster of Paris. These lamps are fitted with four candles, each of which burns for two hours, and as one goes down another is brought into play, so that eight hours' continuous light is given off by the lamp before fresh carbons are required. This particular kind of candle is really an arc, although, to a certain extent, it becomes an incandescent light, because the particles of matter between the ends of carbon assume a very high temperature.

I will now show you an electric arc reflected on the screen. There you now see the two carbon points very close together. The positions of them are reversed to those of actual practice, on account of the reflection. You will now notice the carbons approach and actually touch, but are again instantly separated. This was due to a slight interruption of the current from some cause, but on recovery, as it were, of the current, the carbons separate, and you can observe the process of combustion going on. The light that fills this room is that given off by the lambent flame you can see surrounding the arc; and it is the arc itself which gives off the intense heat producing the flame and light. On close inspection, by reflecting the light in this manner, you can trace out the formation of the light in all its minuteness, even to the little globules that are formed in its production.

To return to the Jablochkoff light. Through the kindness of the Société Generale d'Electricité, who are employed in London in lighting up the Thames Embankment and many other places, we have two wires from their place beneath Charing-cross-bridge brought to this room. The engine which is now pumping electricity for the illumination of the Embankment is also pumping electricity up to us through the two wires I have mentioned, and I will now ask Mr. Berly to throw these currents of electricity into the lamps that are fixed in this room. There, as you see, he merely turns a handle, and instantly the electricity that has been formed underneath Charing-cross-bridge is brought to this room, and acting upon lamps, similar to those I have explained, it produces the brilliant light now filling the room. The light is so intense that the effect of turning the large gas sunlight in the centre of the ceiling on and off is scarcely noticed, and we are now in a cold brilliant light that does not vitiate the atmosphere, and one that is doubtless destined to do great wonders; but undoubtedly its greatest benefit will be to force our Suggs and gas engineers into activity to give us better gas and better burners. The light produced varies with the strength of the current.

A great deal of nonsense has been talked about electricity and about gas. We have been startled lately by telegrams from the other side of the Atlantic; and to those who can read those telegrams properly, they announce nothing but the most outrageous nonsense. We have a correspondent of one of our papers, telegraphing across the Atlantic, that an electric lamp has been produced, which gives for 10d., a light, equivalent to ten thousand cubic feet of gas. Now, ten thousand cubic feet of gas, where I live, cost £1 10s., and to produce anything in the form of an electric light which would do as announced, would certainly be a great wonder. But in the first part of this self-same telegram, it is said that Mr. Edison has produced a light which gives only 16-candle power, and that one horse-power will maintain eight of these lights going. To some this may seem a very extraordinary fact, but to us, who know something about gas and electricity, it is by no means so; for we know that in this City of London we are, at this moment, producing ten times the amount of light per horse power by electricity. Siemens produces in his machine exactly ten times the power of the light recently produced in New York. But more than that, gas itself does just the same as this vaunted light, if not more. The amount of coal consumed in producing one horse power—three pounds weight—will produce 142-candle power by

gas. So that taking Mr. Edison's machine of one horse-power as maintaining eight lights of 16-candle power each, producing a total of 128 candles, the startling announcement in its result comes out actually below the candle power in gas produced by the same quantity of coal; and hence this wonderful discovery that sends our gas stock down, I don't know how many per cent. is really worse in candle power than the gas we burn in London.

However, electricity will certainly have its day. It produces a brilliant and beautiful light. Those who go to the British Museum can read and study under a light as soft and brilliant as that of daylight. There are halls and buildings where gas is injurious to health. For instance, at the General Post-office we have, in a large gallery, over a thousand people at work at a time, and when all the gas burners are going, five million cubit feet of air are vitiated every hour, and of that figure four-fifths are vitiated by the gas. Now, if the electric light be used in that gallery, and the injurious vitiation by the gas prevented, you can see at once what a great hygienic improvement will be affected. I have not the slightest doubt that the introduction of electricity for lighting purposes will not be to the detriment of gas, because the chief value of gas is its heat-producing property, and while the electric light may sweep off, as it were, a certain excrescence of the present method of employing gas for lighting, gas will be brought into our homes and houses for warming and heating purposes to a much greater extent than at present.

There is another point connected with electric lighting, and it is, that in showing you the electric light in this tube I used the muscular power of my arm. In the shed beneath Charing-cross-bridge there is a steam-engine, and there the heat of the coal produces steam in the boiler, which produces motion in the engine. The motion of the engine produces electricity in the machine, and this electricity is transmitted by wires to various places, and there produces heat and light, and so we have a complete interchange of the forces of nature. But we are not dependent upon steam-engines. Water may be used. Windmills and waterfalls are available for the purpose. Dr. Siemens has suggested that the Falls of Niagara might be utilised to light up New York; and, at the present moment, Sir William Armstrong uses a waterfall in his grounds, near Newcastle-on-Tyne, to run one of the wondrous machines, producing currents of electricity, which supplies light for his library.

In giving you these two lectures, especially the one to-night, I have, I know, omitted a great many things that I might have said. I have several experiments on the table unperformed, but we always have a great enemy on these occasions, and that great enemy is Time. It is very difficult in a succinct and clear course to bring these rather complicated facts before you, except by taking them step by step from the earliest and simplest elementary forms to those in which they have been skilfully and practically applied. It is much better, if one wants to know these things, to find out for oneself, as I have said, from practice—by experiment and trial. Reading is very soon forgotten, but facts that are brought to us by trial, by zeal and experiment, are invariably fixed indelibly upon the memory. There is something extremely interesting in all these scientific pursuits, and especially when we find that the applications of science are brought even to our very doors, and have become matters of daily use. Science itself, in all its branches, leads up insensibly from that which is tangible to that which is intangible; from the real to the ideal. But to the mind that is properly constituted, one of the great advantages of even a slight knowledge of a branch of science like this, is that it leads one insensibly "through Nature up to Nature's God."

At the conclusion of the lecture—

The Chairman (Lord Alfred S. Churchill), in proposing a vote of thanks, said:—It now becomes my pleasant duty to move that the best thanks of this meeting be given to Mr. Preece for his most able, lucid and instructive lecture, to which we have attentively listened. I am sure you will all agree to this motion with the most hearty spirit. It has never been my pleasure to listen to a lecture more instructive than this one. It has been with great clearness that Mr. Preece has traced up the history of light from the very earliest days to the present moment. These beautiful lights now before us are among the most remarkable applications of science in the present day. Mr. Preece has favoured us with the many admirable experiments, and I think you will all agree with me in voting him the most hearty thanks of this meeting.

Mr. Preece—Lord Alfred Churchill, and Ladies and Gentlemen:—If it is a pleasant duty to you to accord a vote of thanks to me, it is ten thousand times a more pleasing duty to me to have to accord my vote of thanks, as well as yours, to those who have so ably assisted me in bringing these lectures before you. Without the assistance of Mr. Stroh, Mr. Sugg, Mr. Ladd, Mr. Horne, Mr. Willmot, Mr. Berly, Messrs. Field, Messrs. Siemens, and other gentlemen, it would have been impossible for me to have collected together materials for the performance of the experiments you have seen, and, therefore, your thanks are as much due to those gentlemen, who have assisted me, as they are to me, who have only done my duty.

SIXTH ORDINARY MEETING.

Wednesday, January 14th, 1880; James Glaisher, F.R.S., President of the Photographic Society of Great Britain, in the chair.

The following candidates were proposed for election as members of the Society:—

Andrews, William, 16, Telegraph-street, E.C.
Boldero, John, jun., Norfolk-house, 3, St. John's-wood-road, N.W.
Boult, Alfred J., 323, High Holborn, W.C.
Cole, Granville, Ph.D., 31, Lombard-street, E.C.
Cole, Vicat, A.R.A., Little Campden-house, Kensington, W.
Eckstein, William, 43, Scarsdale-villas, Kensington, W.
Fenner, W. H., Beckton Gas Works, North Woolwich.
Foreman, Ernest, 1, Gresham-villas, Stanstead-road, Forest-hill, S.E.
Hunter, Major C. F., Lawn-cottage, Chipping Barnet, Herts.
Leveson, Edward John, Anerley, S.E.
Merryman, William Henry, 118, Ledbury-road, Bayswater, W.

Payne, Everett Jesse, Messrs. John Hall and Co., 79, Cannon-street, E.C.
Perry, The Right Rev. Lord Bishop, 32, Avenue-road, Regent's-park, N.W.
Reay, Lord, 6, Great Stanhope-street, W.
Rose, George Daniel, 28, Page-street, Westminster, S.W.
Russell, Thomas, F.R.G.S., Haremere-hall, Hurstgreen, Sussex.
Shaw, John, College-place, Derby.
Shean, Arthur William Charles, F.R.G.S., 18, Finsbury-circus, E.C.
Thomson, James Duncan, St. Peter's-chambers, Cornhill, E.C.
Turnbull, Alexander, 118, Belsize-park-gardens, N.W.
Wood, John Denniston, 82, Ladbroke-grove, Nottinghill, W.
Wood, Thomas, Stafford.

The following candidates were balloted for and duly elected members of the Society :—

Bayley-Worthington, Gibbon, 2, Porchester-gate, Hyde-park, W.
Couchman, Colonel, 40, Pembridge-villas, W.
Garston, W. E., Blenheim-house, Marlborough-road, N.W.
Hall, John Parkinson, Crane-house, Great Yarmouth.
Peake, W. H., 29, Gerrard-street, Soho, W., and Balham.

The paper read was :—

MODERN AUTOGRAPHIC PRINTING PROCESSES.

By Thomas Bolas, F.C.S.

Although the lithographic method, as carried out in conjunction with the steam printing machine, forms, in the case of large commercial orders, by far the most convenient autographic printing process, there are innumerable occasions which call for the rapid production of small numbers of autographic prints. Of late years many very convenient methods of attaining this end have been devised, but before illustrating the more important of these to you, I should like to show you how simply and easily zincographic printing can be performed in an amateur fashion; zincography being similar to lithography, except that a zinc plate is employed in the place of the lithographic stone.

Here is a sheet of the so-called transfer paper; this being merely a moderately fine paper which has been brushed over, on one side, with a mucilaginous mixture prepared by boiling together the following materials :—Water, 1,000 parts; starch, 100 parts; gamboge, 6 parts; glue, 1 part. I will now write on the transfer paper with the ordinary commercial lithographic writing ink, this having been rubbed up with water like an artist's water-colour. The writing being now dry, it is necessary to somewhat moisten the back of the transfer by means of a damp sponge; after which it is laid, face downwards, on a sheet of ordinary roofing zinc, this having been previously cleaned by means of emery cloth. Both being now passed together under the roller of this small press, you see that the transfer adheres to the metal plate; but on damping the back of the paper, it becomes easily removable, leaving the writing on the zinc. The face of the zinc plate is now gently rubbed over with mucilage of gum arabic, which, by the bye, is all the better for being slightly sour; and the excess of gum having been sponged off, an india-rubber inking roller, charged with ordinary printer's ink, is passed over the still damp zinc plate a few times. The ink, as you may see, takes only on the lines of the transferred writing, and it is now merely necessary to lay a sheet of white paper on the plate and to pass both through the press in order to obtain an impression—an exact reproduction of the original writing, as you see. Any number of copies can be printed by repeating the operations of damping and inking; while the zincographic process, as thus simplified, is rapid, economical, and within the reach of everyone.

The lithographic process, as also the zincographic, is often used with great advantage in conjunction with photography; especially in those cases where the original writing was not executed in the saponaceous ink which is used for transference to the stone or the zinc. As I recently illustrated, in this room, the various methods of preparing a transfer by photographic means, it is not necessary to enter into any particulars at the present time. I have, however, placed on the table some stones bearing photolithographic impressions, together with some prints and transfers produced by the agency of photography.

I wish to call your attention to a very successful application of photography to autographic printing as regards long numbers. This small volume, called "Dramatic Notes," is a very readable little book, recently published by David Bogue; and the numerous illustrations therein would, at first sight, be naturally taken for impressions from wood blocks or other typographic printing surfaces. This is not, however, the case; the illustrations being, in reality, photo-lithographs: and they were printed on the sheets after the typographic matter had been impressed, blank spaces, being, of course left for them. It is very interesting thus to find photolithography in successful competition with block printing for book work. In this case the photolithographic work was executed by Mr. W. Griggs, of Peckham.

For a long time zincography and lithography were, to all intents and purposes, the only autographic printing methods in use; if we except the ordinary copying process on thin paper, and Wedgwood's manifold writer; but neither of these requires consideration in the present communication. In the year 1871, Mr. E. de Zuccato introduced a process which he termed "electro-chemical printing," and I will proceed to illustrate the principle of this invention; although, as a matter of practice, it is now superseded by other processes.

Here is an iron plate which has been varnished over with a resinous varnish, and by means of a steel point I will trace through the varnish so as to lay the metal bare in places. The iron plate is now laid on the bed of a press, and some sheets of thin paper, moistened with a solution of potassium ferrocyanide, are placed on it. A copper plate being now put over the moistened paper, moderate pressure is applied. The iron plate is next connected with the carbon of a voltaic battery, while the copper plate, which covers the moistened paper, is connected with the zinc of the battery. Under these circumstances the iron dissolves at all these places where the varnish was removed by

means of the style; and Prussian blue being formed by reaction with the potassium ferrocyanide, parts of the papers become imprinted with blue characters, these corresponding exactly with the original tracings on the varnished iron plate. You see that the writing is imprinted on each of the sheets of paper used, and as the colouring matter goes quite through, the writing can be read from either side.

This method of printing was suggested by Bain's electro-chemical telegraph; and it has itself suggested to Mr. Zuccato another and simpler method of printing, which he calls "papyrograph."

Here is a sheet of fine paper which has been saturated with a resinous varnish and dried. On it I now write with an ink consisting of a strong solution of caustic soda, slightly coloured in order to be more obvious to the eye. The soda immediately attacks the resinous preparation of the paper, converting it into a soap. The sheet is now floated on water, the written side being upwards; and the water soon penetrates the softened parts making the written lines to stand up in bold relief as ridges of fluid. The paper is now removed from the surface of the water and pressed between folds of blotting paper, after which it is once more floated on the surface of the water and again blotted off, in order to remove the remainder of the resin soap. The sheet thus prepared forms a stencil of which the general ground is impervious to moisture, while the written lines being denuded of varnish, are, therefore, quite porous, and they afford an easy passage to an aqueous liquid. In the early days of papyrograph printing, a pad, saturated with persulphate of iron, was placed at the back of the stencil, while the paper to be printed on was moistened with a solution of ferrocyanide of potassium. The iron salt being forced through the porous lines by a gentle pressure, reacted on the ferrocyanide; a blue impression was the result. It is now, however, found to be more convenient to print from the stencil by means of an aniline colour dissolved in glycerine, and the colouring power of this kind of ink is so great that dry paper may be used for receiving the impression. Here, then, is a velvet pad which has been moistened with a solution of aniline blue in glycerine, and on it I lay the paper stencil, this having been previously brushed over at the back with a little of the ink. It is now merely necessary to place sheets of paper on the upper face of the stencil, and to apply gentle pressure by means of an ordinary copying press, in order to obtain copies rapidly and easily as you see. The copies can be printed off more quickly by this process than by typography or lithography; the comparison being of course made with these processes as worked at hand presses. About six hundred copies can generally be printed from one stencil.

Over at yonder table Mr. Perry is printing off papyrograph prints with great rapidity, and, although he has already obtained several hundred copies from the stencil which he is using, the present copies are quite as good as the earlier ones.

Let us now pass on to the consideration of another class of printing stencil, this kind being made by the mechanical perforation of a suitable paper or tissue. Stencils perforated by a rapidly rising and falling needle point, actuated by a treadle, have long been used for the printing of embroidery patterns. In such a case, powdered colour, mixed with resin, is dusted through the stencil, after which the device is fixed by the application of sufficient heat to soften the resin. Edison proposed to use such perforated stencils for ordinary autographic printing purposes, and he has ingeniously replaced the complex treadle perforating machine by a kind of pen, in which a needle point is made to move rapidly up and down by means of a small electric motor attached to the instrument. As early as 1866, however, Huffman introduced and patented a portable perforating pen, the motive power in this case being clockwork, contained in a cylindrical box attached to the upper part of the apparatus.

Here, then, is Edison's electric pen, and you see that when I connect the terminal screws of the electric motor with a battery of two elements, the needle rapidly passes in and out of the perforated point of the instrument. If I now write with it on a piece of black paper, this paper becomes perforated, and I can make the perforations obvious to you by using the perforated paper as a magic lantern slide. In order that you may better understand the nature of the electric engine which drives the perforating needle of Edison's electric pen, I have placed on the table two models of electric engines, which I will now set to work, and you can examine them at your leisure.

This sheet of ink-proof paper has been written on with the electric pen, and you see how easily it can be used as a printing stencil. I merely lay it down on a sheet of white paper and pass an inking roller over its back—you see that the ink, in passing through the perforations, has reproduced the original writing with great perfection; and the operation of printing is very rapid, so that many copies can be produced in a short time. Other perforating pens have followed in the wake of Edison's electric instrument, among which may be mentioned the horograph, a very convenient and portable clockwork pen, which is manufactured by Messrs. Newton, Wilson, and Co., of Cheapside. Here is the instrument, and yonder are some specimens of work done with it. A pneumatic pen, in which the motive power is a stream of air supplied from a foot bellows, has also been introduced into the market. A still more complex and expensive arrangement than either of the preceding for producing perforated stencils, consists of an induction coil, capable of giving a sufficiently powerful spark to perforate the stencil paper; and this spark is made to continually pass between a partially insulated metallic pen and a metal plate, on which the stencil paper is laid.

All the above described perforating arrangements have the disadvantage of being expensive, complex in construction, and liable to get out of order when used by unskilled persons, while the perpendicular position in which the mechanical perforating pens must be held, necessarily hampers the freedom of the writer. These objections have been very completely overcome in a new perforating method recently introduced by Mr. Zuccato. In this case, the impervious stencil paper is laid on a hardened steel plate, cut on the face like a fine file, and the writing is executed by means of a point or style of hardened steel. Under these circumstances, the teeth of the file-like plate perforate the

paper wherever the point of the style exerts pressure, and a stencil eminently adapted for printing from is the result. Here is a small model of the apparatus employed by Mr. Zuccato for this kind of printing, and called by him the trypograph. I now lay a sheet of the prepared paper on the file-like plate and write with the hardened steel pencil, the operation of writing being as easy as if a black lead pencil were employed. Let us now fix the stencil on the frame of this little desk-like press, place a sheet of white paper underneath, and then push over the upper surface of the stencil, an india-rubber scraper or squegee charged with printer's ink. You see that the ink passing through the perforation has produced a copy of the original writing, while Mr. Neale, who is printing by this method at the other end of the table, affords sufficient illustration of the rapidity of this method of autographic printing, by which as many as six thousand copies can be obtained from one stencil.

In order to illustrate to you the nature of the trypograph stencil, I will project the image of one on the screen; and let us employ one made of sheet aluminium, thin metallic plates being readily perforated by Zuccato's method. You now will notice that the perforations are quite distinct from each other, although when the stencil is printed from, the dots of ink so far flow together as to produce nearly or quite continuous lines.

Let us now project the image of electric pen stencil on the screen, so that you can see the clear round perforations produced by the vibrating needle, and compare them with the results obtained by the trypographic method.

It may interest you to know that Mr. Zuccato has just found that calico receives the trypographic impression admirably, and he has executed some specimens which will now be passed round.

Mr. Pumphrey, of Birmingham, has introduced a method of autographic printing which he terms collography, and its working depends on the fact that when a film of moist bichromated gelatine is brought into contact with ferrous salts, tannin, or certain other substances, the gelatine is so far altered as to acquire the property of attracting a fatty ink. Mr. Pumphrey supplies plates of slate or glass covered on one side with a thin film of gelatine, and these are prepared for use by being soaked in a weak solution of potassium bichromate, all excess of moisture being then removed by first wiping with a cloth and afterwards rolling paper on the damp surface. A drawing or writing, which has been made with either an ordinary iron and gall-nut ink, or with a special ink, is now transferred to the prepared plate, just as in the case of the transfer to zinc. The original being now removed, the plate is inked by means of a roller, moistened by a sponge, in order to remove any trace of ink from the ground, and then printed from, much as if it were a lithographic stone, or a zincographic plate. I can hardly afford time to illustrate this process to you, but some prints on the table will enable you to judge of its capabilities.

We now pass on to the study of some methods, which are rather copying processes than printing methods, as they depend on the writing of an original with a very intense ink, and then dividing the ink, so as to obtain a number of feebler copies. The ordinary method of obtaining one or two reversed copies of a letter on thin paper is of this nature; but it requires no description here; but those processes which are capable of yielding 30 to 60 fairly good copies depend on the use of a solution of an aniline colour for writing: colours of this class being in general exceedingly intense. In the case of copying processes introduced by Pumphrey and Byford, the writing is executed with a strong solution of an aniline colour on thin, and tolerably hard, paper, just as you see me doing now. You will see that the writing has quite penetrated through the thin paper, and on pressing a sheet of moistened paper against the back of the original, some of the aniline colour will set off on the damp paper, giving a direct copy of the original writing. In the same way numerous copies may be produced; but processes of this kind cannot reproduce very fine lines with distinctness. A somewhat analogous arrangement for obtaining numerous copies is afforded by Waterlow's multiplex copying portfolio and its contents. You see that I write with the aniline ink, and press down a damp sheet of very soft and porous paper on the writing. This soft paper absorbs a large proportion of the aniline ink, and itself forms a reversed printing surface, capable of yielding a considerable number of direct copies to damp sheets of paper.

The above described copying processes all labour under the disadvantage of requiring the use of damp paper for receiving the impression, but the difficulty has been overcome in an arrangement which has been extensively sold under the names of hectograph and chromograph; these differing from each other rather as regards detail than kind.

The writing is executed on ordinary writing-paper with an aniline colour ink, and when the lines have dried, the original is transferred to the surface of a slab of soft gelatinous composition, analogous to that used for making printers' rollers, contact being established by a gentle rubbing with the hand. The original, after being allowed to remain in contact with the gelatine slab for about two minutes, is stripped off, leaving the greater part of the ink on the gelatine. To obtain the copies, it is now merely necessary to lay paper on the slab and either rub down with the hand or establish contact by means of a soft roller. The requisite number of copies having been obtained, or the colour on the lines being exhausted, the slab can be cleaned by means of a damp sponge, when it is again ready for use.

The representative of the Hectograph Company, who is now printing, has executed a series of very artistically drawn prints in various colours; aniline colour inks being, I believe, used in every case.

A composition for making the slab may be prepared as follows. One pound of gelatine is soaked in water until it becomes flaccid, after which it is melted, in a water bath, with six pounds of common glycerine; the heat being maintained for a few hours so as to drive off all excess of water. The mixture is then poured out into zinc trays half an inch deep, and allowed to set.

The ink may be prepared by dissolving one part of aniline violet (blue shade) in a mixture of seven parts of water and one of alcohol.

Since the advent of the chromograph, a multitude of similar articles have been sold under various names in which, however, the terminal

syllable "graph" has generally been retained. So numerous have these "graphs" become, that some enterprising individual, perhaps an American, has recently introduced into the market a "Lick-'em-all-graph."

Autographic engraving processes, such as relief etching on zinc, the grapho-glyphic process, and the production of autographic blocks by such an engraving machine as that of Shanks and Johnson, do not come within the scope of the present paper, as they would require to be treated of at considerable length; but Mr. Dallas, of phototypic fame, has kindly brought some admirable specimens of autographic printing, done by his block process. Here, for example, is a reproduction of one of Mr. Gladstone's post-cards, and it is so well done as to be hardly distinguishable from the original.

Mr. Chapman has kindly lent me specimens of a photographic process, especially adapted for reproducing engineers' plans, and it is likely to be of very great value to large firms, who often require several copies of important and complex plans. This process was invented by the well-known French chemist, Pellet, and the original plans were drawn on tracing cloth, or paper, with an opaque ink. The original drawing is placed in an ordinary printing frame, and behind it is placed a corresponding sheet of the sensitive paper, this being supplied by the patentee ready for use; it is a merely a stout paper, coated with a mixture of perchloride of iron, an an easily oxydisable organic matter. The printing frame being now exposed to light for a short time (one minute in sunshine being often sufficient), the persalt of iron becomes reduced to the state of protosalt wherever the sensitive paper is unprotected by the opaque lines of the original tracing. After removal from the printing frame, the exposed sheet is immersed in a strong solution of potassium ferrocyanide, and this substance, reacting with the persalt of iron remaining on those parts of the paper protected by the opaque lines, gives rise to the production of Prussian blue, while the general ground of the paper remains white. It is now merely necessary to wash the print, and to soak it in dilute hydrochloric acid, in order to remove superfluous matter, a final washing being of course necessary to remove the free acid. The old ferroprussiate process, which gives white lines on a blue ground, found little favour with engineers, as the exposure required is long, and it is naturally impossible to tint or colour the prints. Neither of these objections applies to Pellet's process. I should like you especially to notice yonder copy of a working drawing of a locomotive engine, the sheet of paper on which it is executed being over five feet long, while the fineness of detail recalls a copper-plate engraving. To reproduce such a work by hand would cost more pounds than the photographic copy costs shillings, and even then there would not be the same certainty as to perfection of results.

DISCUSSION.

The Chairman, in inviting discussion, asked gentlemen who might take part in it to give the result of their experience in the use of the various methods which had been described.

Dr. Mair said they were all much indebted to Mr. Bolas for his clear account of these different processes, but while he had described how they were done, he had not perhaps gone sufficiently far in explaining why they were done, nor had he said anything on the great advantages which the commerce of the present day derived from them. There could be no doubt that but for the introduction of these processes, commerce would be in a much worse condition than it now was, since it had enabled merchants and others to put quotations and other information before their *clientelle* in a much shorter space of time than was the case formerly, when printing was the only method of doing so. By the time the merchant's messenger got to the printer, he could have a great number of his circulars struck off, and he was thus enabled to send his quotations up to the very latest hour. Perhaps the only people who had not benefited by the invention were the printers. He was the editor of "Debrett's Peerage," and had assisted in sending out many thousands of circulars of very various description. He had tried all the new processes as they came out; Waterlow's autographic process, the electric pen, the chromograph, the hectograph, the trypograph, and the rest, the best, in his opinion, being the last-named.

Mr. Christopher Cooke said there was a specimen of the autotype process in the British Museum, being a copy of John Milton's "Common Place Book," taken from the original manuscript. He should like to know what had become of the Autographic Mirror Company, to which, some years ago, he sent some autograph letters (amongst them being one of Lord Byron's), on the promise that they sho uld be returned, but he had never heard of them since.

The Chairman then proposed a vote of thanks to Mr. Bolas for bringing together so much interesting matter, and illustrating it to them so lucidly. The trypograph, he understood, would give many hundreds of copies, either on linen or paper, and this was confirmed by Dr. Mair's experience; so that in cases of large numbers it seemed just the thing required. But a process was also wanted by which from 20 to 40 copies could be readily struck off. He knew men who had been trying for some years since "graphs" first came out, and still they complained of the difficulty of getting the later copies clear. He had in his hand a copy of something sent him by Mr. Alexander Herschel some time ago, giving a description of a fire-ball he had observed; but when he got to the third page, it was so indistinct he could not read it, and had to send it back to be inked over. If a remedy for that evil could be found, it would be a great point; and he understood from Mr. Bolas that the chromograph would give 100 copies.

Mr. Bolas said he could not guarantee that. The ink was gradually exhausted, and, of course, the impressions would gradually get fainter.

The **Chairman** said that probably, as an actual working process, it would not give more than 50 copies, but that would be a great point gained, so that if he observed a meteor or a fire-ball, he could readily send a description of it to his correspondents. He felt that they were much indebted to Mr. Bolas, and he hoped that on some future occasion that gentleman would bring before them an account of such further improvements as might be made in these autograph processes.

The vote of thanks was carried unanimously.

The Agricultural yield of the United States for the present year is calculated as follows:— Butter, 170,000,000 dols.; cheese and milk, 130,000,000 dols.; beef, fresh and tinned, 270,000,000 dols.; pork and bacon, 250,000,000 dols.; Indian corn, 410,000,000 dols.; wheat, 400,000,000 dols.; total, 1,630,000,000 dols.

MISCELLANEOUS.

ARTISAN REPORTS.*

II.

Among the instructions given to the artisan reporters as to the points to which their attention was to be especially directed, were several relating to the condition of the French workmen. Most of them, therefore, devoted a portion of their space to these matters, and an abstract of the opinions expressed, drawn from the various reports, will now be attempted. The order of arrangement in which the various points can most conveniently be considered will be—1. Hours of work and wages; 2. Rent and cost of living; 3. Organisation among workmen; 4. Technical schools and art teaching; 5. Home life.

(1.) *Hours of Work and Wages.* — The long hours general among French workmen in all trades is remarked upon with surprise by every reporter, and each one tries to prove that the English workman does as much or more during his short hours as the Frenchman in his long ones. The workmen's day consists of from 10 to 12 hours, and the time of commencing work varies in the different trades. The potter works his 60 hours per week, beginning each day at 6 a.m. and leaving off at 6 p.m (p. 31). Sunday frequently takes the place of the Saturday in England, and the workman is at his factory from 6 to 11 a.m. on that day. Mr. Bedford remarks that "the men, in endeavouring to get as much pleasure as possible during the brief respite, frequently overdo the thing, and are not able to resume work till the Tuesday morning, or, if they do come on the Monday, can scarcely be prevailed upon to do a fair day's work" (p. 101) Mr. Letheren was informed that the men employed on ornamental ironwork often work from 12 to 7 or 8 o'clock without stopping to take food (p. 170). Mechanical engineers work twelve hours in the day, and Mr. Curley believes that at least one-third of the working people of Paris, men and women, work 11 hours on Sunday just the same as on week days (p. 364). Printers work 11 hours a day in summer and 10 hours in winter. Mr. Berry writes:—"The working day in Paris commences at 6 a.m. The first meal is taken at 10, and, in some cases, at 11 o'clock, varying in different quarters. Work re-commences at 12 and 11 respectively. No authorised pause takes place until 5.30 or 6 o'clock in the evening, whichever time is being worked; but the men may, if they choose, go out at 2.30 p.m. for luncheon, half an hour being allowed. This second pause for luncheon is generally adopted by those who work on till 6 p.m. Those who leave off at 5.30 p.m. do not, as a rule, adopt it" (p. 351). Saddlers work from 7 a.m. to 6 p.m., and some printers the same, others being occupied from 7 a.m. to 7 p.m. Stone carvers only work from 8 a.m. to 5 p.m. Mr. Berry says that a movement has been started in Paris which aims at the reduction of the hours of labour. With regard to the wages, it appears that potters earn from 25 to 40 francs a week. Mr. Bedford, the reporter on "Terra Cotta," gives fuller particulars. He says that the wages of mould-makers are 7 francs a day, of pressers and tile-makers, 6 to 7 francs, and labourers 3½ to 4 francs. Mr. Leicester thinks the wages paid to glass-workers are higher than in England, but Mr. Letheren finds wages generally lower in France than in England. Mechanical engineers are paid at the rate of 5½ francs for the day of 11 hours, but smiths can earn 8½ francs in the day of 12 hours. The following rates of wages are given by Mr. Hopps:—Fitters, 6 to 7 francs; turners and smiths, 6 to 7½; and pattern-makers, 7 to 9 for the day of 10 hours. Wages are slightly higher in the smaller factories (p. 254). Rollers and furnacemen in the iron and steel manufacture can earn from 14 to 16 francs a day. Workers in plaster make, on the average, 7 francs a day, and the modellers are paid from 1 franc to 4 francs an hour, according to their abilities. The day wages of a stone-carver vary from 10 to 12 francs. A first class mason gets from 8 to 10 francs a day; a second class, or rough mason, from 6½ to 7 francs. The pay of an ordinary bricklayer is about seven francs a day, but a good printer can earn about 15 francs with ease (p. 452).

The following table will show the weekly wages given at some of the chief Parisian printing offices. At M. Gauthier-Villars' office the qualification for the position of reader is a superior knowledge of his own language, and some acquaintance with mathematics:—

	Gauthier-Villars.	Quantin & Co.	Chaix & Co.	Dupont & Co.	National Printing-office.	Chamerot (late Firmin-Didot).
Readers	£2 to £3 10s.	£1 12s. to £2.	£1 16s. to £2 15s.	£2.	£2 to £3.	...
Compositors	At rate of 7d. per 1,000.	7d. the 1,000 (clicker or head of the companionship, £2 to £2 10s. per week.)	£1 15s. to £2.	7d. per hour.	7d. the 1,000.	6½d. to 7½d.
Pressmen	£1 10s. to £2 2s.	...	...	...		
Machine minders	£2 to £2 17s.	...	£1 18s. to £2 17s.	...	£2 to £3.	£2.

Cabinetmakers' wages average from 6 to 7½ francs a day, but as much as 2 and 3 francs an hour had been paid for Exhibition work. Shoemakers only receive 30 francs a week for 72 hours work (p. 600).

Mr. Grant reports that the average wages of the agricultural labourer is only 1s. 8d. a day. Gardeners receive from £2 to £3 a month, with board and lodging. Mr. Bedford remarks that "the wages of the Danish workmen (potters) appear to be much the same as are paid in this country, the decorator who paints for the market from the artist's original receiving from 30s. to 40s. a week, and the turners about the same sum. But the thrower, who in England is usually paid from 50s. to 60s. per week, only gets from 30s. to 35s. in Denmark." Mr. Fraser says the wage rate for the cabinetmakers is better in France than in England, and far above that paid in Ireland (p. 435).

Piecework is described as general amongst many of the trades. Mr. Turner writes, "It is very much in favour with the French stone carvers, nearly all good carvers being piecework men. It is in favour both because it gives more liberty in working hours, and because it augments the rate of wage, at the same time that it allows the men the opportunity of working as they please, commencing or leaving at their pleasure, often not commencing until nine or ten o'clock in the morning, and continuing until seven or eight o'clock in the evening" (p. 223). Piecework is carried on by bricklayers to a large extent in the outskirts of Paris,

* The Society of Arts Artisan Reports on the Paris Universal Exhibition of 1878. (London: Sampson Low, Marston, Searle, and Rivington, 1879). Price 7s. 6d., or, 5s. 8d. to members of the Society of Arts and exhibitors at the Exhibition. [Part I. appeared in *Journal* of January 9.]

as well as in the country, and Mr. Berry gives a list of the prices paid for different kinds of work (p. 351). Mr. Connolly points out that the French system of fixing prices is not the same as the English. The quickest workman is not taken as a standard, but the work of a good average man is set as a guide to the price to be paid. In some printing offices, where the work is done by piece, "one man sometimes contracts for the whole job, and the workmen employed under him are paid by the day, or the contractor again sublets part. At other times a number of men contract for the job, and each man is paid according to what he is rated at, whether it is 4s., 5s., or 6s. a day, and when the job is finished, the money that is over is equally divided amongst the workmen, with regard to their rate of wages" (p. 521).

Overtime is not universally paid for at an increased rate; in printing offices it is usually calculated at one-third more than the ordinary rate, but amongst saddlers double pay is given. Mr. Berry gives the following information respecting the extra payments among bricklayers:—"After 6 p.m. till 7 p.m., or for the first hour, 20 centimes, or 2d., extra for the hour; from 7 till 8 p.m., quarter time extra; after 8 o'clock double time is charged and paid" (p. 351).

The general opinion of the reporters is that female labour is paid rather better in France than in England. Apprentices in the printing trade, begining at the age of 14, are paid about 5s. a week during the first year, 10s. in the second, and about £1 in the third year, according to skill. By the law of 19th May, 1874, children of less than 12 years of age cannot be employed in factories and workshops, but an exception is made in 14 specified industries, in which children may be admitted as half-timers at the age of 10.

Wages are ordinarily paid monthly, but fortnightly payments are becoming more general. Very few houses pay weekly, M. Gauthier-Villars's printing office is one of these. Among the bricklayers the men are asking to be paid after the English fashion, or weekly.

This question of wages and hours of work has necessarily a considerable bearing on the price of the thing produced, and Mr. Leicester has made some elaborate calculations in respect to the production of table and fancy glass, and he ascertained that the glasses used in most of the London hotels are nearly all of foreign make, as these can be bought abroad at a less cost than those of English manufacture (pp. 141-2). Mr. Bedford gives a comparative list of prices for terra cotta work. Mr. Hopps writes in explanation of a table of his:—"It will be thus seen that the price of the French 8-horse power engine is from 1,550 francs to 1,750 francs, or from £62 to £72 higher than that of the English engine; and that the American is 100 francs, or £4 cheaper than the English engine. As to the matters of quality or design, however, the less that is said the better" (p. 267).

(2.) *Rent and Cost of Living.*—The reporters differ considerably as to the charge for house rent in Paris, thus one thinks that the average is cheaper than in London (p. 224), while another affirms that for the accommodation given, it is decidedly dearer (p. 622). Mr. Ives speaks of the workman's lodgings costing him three francs a week (p. 292), while Mr. Hopps puts the rent at from 250 to 300 francs a year (p. 257), and Mr. Lowson the same accommodation at 300 francs (p. 528). Mr. Hancock fixes a still higher standard, and sets down the rent of two rooms at from 7 to 9 francs a week, according to locality (p. 589), and Mr. Harris fixes 40 francs a month as the average rent for an unfurnished room or rooms (p. 31). Mr. Bright considers that the English workmen are fortunate in the possession of the little cottages round London, as the Paris workmen have no such luxuries. The latter cannot well live beyond the barriers of the French metropolis, because they have no cheap and early conveyances, such as workmen's trains or trams (p. 515). Mr. Warwick describes the accommodation provided by Messrs. Japy Brothers, of Beaucourt, clock manufacturers, for their workmen. "They have taken into consideration the mode of life of their workmen, and have built houses for them to live in, adapted to their occupation. They employ from 11,000 to 12,000 hands, and have constructed from 400 to 500 houses, and still continue to build. These are six-roomed houses, with a bench and lathe in one room for a workshop. A model of these houses, about 3 feet high was shown; a cross section opened that the interior arrangement might be seen. The houses cost 3,400 francs to build, and the men pay 35 francs per month as rent to the firm, who hold the property as a kind of building society until the cost of building has been repaid, when the houses, subject to certain conditions, becomes the property of the occupant. The wages vary from 3 to 10 francs a day" (p. 463).

The same divergence exists in the estimation of the cost of living as in that of lodging. Mr. Harris considers that the French artisan lives much cheaper than the Englishman (p. 32), an opinion coincided in by Mr. Turner (p. 224), but Mr. Connolly believes that the Frenchman pays as much for his two meals a day as the Englishman does for his three (p. 622). Other reporters remark on the dearness of provisions in Paris, and Mr. Hopps says that the cost of living during the Exhibition was fully 50 per cent. more than it was in 1877. He adds that "flesh meat is never taken by French workmen more than once a day, and in many cases only on three days per week" (p. 256). Mr. Berry gives the following particulars as to the cost of living:—"The first meal, or ordinaire, which is taken about 11 o'clock, can be had by workmen for from 45 to 60 centimes or 4½d. to 6d. The evening meal or dinner costs between 6d. and 8d. The prices in detail are, soup 1d., meat 3d., bread ½d., wine 2d. . . . In the neighbourhood of Père Lachaise and the Rue de Roquette, meals are provided from 45 to 55 centimes, including wine. The meal then comprises broth or bouillon ½d., boiled beef 2d., and bread ½d." Other reporters put the dinner at a franc, and Mr. Connolly writes, "*Déjeuner* costs from 1 f. 10 c. to 1 f. 30 c.; dinner from 1 f. 80 c. to 2 f. 10c., according to taste, or as the men are married or single" (p. 622).

The reporters are unanimous that clothing is considerably dearer in France than in England, but this is equalised by the common character of the clothes worn. Mr. Berry writes: "The clothes worn by the building operatives are of a very cheap description, consisting of a blouse and trousers of cotton material and a cap. An outfit of this sort, including boots, costs about 25 francs" (p. 394).

(3.) *Organisation among Workmen.*—Most of the writers are struck with the different arrangements in this matter in France. Mr. Ives states broadly that "In Paris there are no trades unions or other societies. Sick and funeral societies are not much patronised, and when a French workman is out of employment or in distress, he is employed by the Government on public works, or has to depend entirely on private benevolence" (p. 271). Mr. Leicester considers the French workman to be much worse off than his English fellow in this respect, and expresses his wonder as to what becomes of the old, the infirm, the unemployed, and the sick, and of the orphans and helpless widows (p. 154). Other writers point out what the French workmen have in place of trades unions. Mr. Bright describes the "Mutual Aid Society," and "Bonus and Superannuation Fund," established at Messrs. Chaix and Co.'s printing office. By the latter an apprentice who has remained in the office as a journeyman, is insured an annuity of about £16 on attaining the age of 55.

Trades unions can only be communal, as the laws forbid such amalgamated associations as are common in England. Mr. Hopps writes: "Political feeling runs so high in France that the trades unionists are constantly introducing it into their club rooms, and the result is that splits are caused in their ranks, and

men are driven away from them who would otherwise remain" (p. 455). Mr. Paul refers to a society, composed of members of all the different trades, which has lately been formed, under the name of "L'Union des Travailleurs," but the rules are almost wholly of a political character, and the primary object of the association is the production of a Republican newspaper for social democratic women, called *Le Proletaire* (p. 426). A point worth noticing under this head is, that the French cabinetmakers do not possess many tools. Three pounds would cover their value, while a West-end London cabinetmaker's stock of tools would average quite £20. The French masters find the rest of the tools (p. 425).

(4.) *Technical Schools and Art Teaching.*—There is but little difference of opinion among the various writers in respect to the facilities enjoyed by the foreign operatives for acquiring a good scientific and artistic education. "Masters are compelled by law to allow their apprentices facilities for getting theoretical knowledge in the evening, and are, therefore, forbidden to keep them working overtime. In every arondissement in Paris there are night-schools and science classes, where instruction is given free by the most imminent scientific men and professors in Paris" (p. 256). Mr. Hopps set himself the task of describing the means adopted for the education of apprentices in France, visiting for that purpose the "Municipal School for Apprentices" in the Boulevard Villette, and after setting forth the advantages of this establishment, he draws a picture of the neglected education of the English mechanic. Still he thinks that much of the fault lies with the workmen and apprentices, who are indifferent to such opportunities as they do possess, because they are too ready to despise and sneer at the smallest inkling of theory (p. 274).

Mr. Hancock is not prepared to endorse the prevalent opinion that the early training of French workmen does produce the best mechanics. "At the age of 20 they have to take their chance in the ballot for conscription, and, if unfortunate enough to be drawn, they have five years in a barrack, which is long enough for them to forget all they have learned. Should they escape the conscription, they are almost sure to be placed in the reserve, and to be called up for 28 days' military training each year. The result of all this, as I was informed by leading French workmen, is that one-half of those who get a start in the trade do not follow it, and that a number of those who do persevere are not such good workmen as they otherwise would be" (p. 589).

Mr. Ganney considers that the horological schools of Switzerland have been very successful, and that the work of their pupils equals the best efforts of the most skilled workmen (p. 446). Mr. Bright describes the Professional School, established in 1862 by M. Napoleon Chaix, in connection with his printing office. This gentleman was of opinion that the instruction should embrace an ordinary scholastic course in addition to a technical one, but there was an evident indisposition on the part of the apprentices to avail themselves of the privileges accorded to them. Mr. Chaix wished to avoid compulsion, and solved the problem of obtaining a regular voluntary attendance by the issue of a *jeton de présence* (to which the value of one penny was attached) to every apprentice who attended the classes and conducted himself satisfactorily (p. 500). Mr. Paul notices a society founded in 1866, for the purpose of providing professional education for cabinetmakers, which bears the title of "Patronage of Children in the Cabinet-making Trade." In connection with this a school has been opened for instruction in drawing applied to furniture decoration and modelling. In respect to artistic education, all the writers seem to be unanimous as to the advantages enjoyed by the Paris workmen, both from the fostering influence of the State, and from the general atmosphere of art that surrounds him and imbues him with knowledge almost before he is aware of it. One sees in each of the buildings a school of design for the designer, carver, or modeller, and another holds that the streets of Paris furnish to the stone carver an interesting and instructive series of illustrations for his work. Others think that we need feel no surprise at the superior taste of the Frenchmen, when we remember that the churches contain rare specimens of art work, and the galleries and museums are open on Sundays and in the evening.

(5.) *Home Life.*—This does not commend itself to the taste of any of the reporters, and all of them were struck by the want of home comforts in the rooms of the Paris workmen. Mr. Harris writes—"In nine cases out of ten the man and woman both work . . . and it is usual to leave the child or children in the care of the woman of the house" (p. 31). Mr. Lowson says, on the same subject, "the women, instead of attending to their maternal duties, continue to work, and the children are boarded out somewhere in the country districts, where the living is cheap. They pay from 30 to 40 francs for one child's keep, or about 1s. a day of our money, with an occasional present of a kilo. (about 2¼ lbs.) of sugar" (p. 526). With father and mother both at work, meals taken abroad, and children boarded out, home can be little more than a sleeping place. The soberness and thrift of the French workman is remarked upon by most of the reporters as striking points in his character. Mr. Lowson says, "besides being sober, the French working classes are also very thrifty. Let their wages be ever so little they save something. There are few in our trade (printing) who did not save about half-a-crown a week; with married people, the wife helps in this from her earnings. Even the most worthless characters amongst them appeared to save something, if only a single penny a day" (p. 527).

MEETINGS OF THE SOCIETY

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

January 21.—"Domestic Poisons." By Henry Carr. John Simon, C.B., F.R.S., will preside.

January 28.—"The Future of Epping Forest." By William Paul, F.L.S. John T. Bedford, Chairman of the Epping Forest Committee, will preside.

February 4.—"Trade and Commerce with Siberia, *viâ* the Kara Sea." By Henry Seebohm.

February 11.—"A New Metallic Compound and its Application to Industrial and Artistic Purposes." By Granville Cole, Ph.D.

February 18.—"The Euphrates Valley Railway." By W. P. Andrew.

February 25.—"The Art of the Silversmith." By W. Herbert Singer.

March 3.—"The History of Musical Pitch." By Alexander J. Ellis, F.R.S.

March 10.—"Recent Advances in the Production of Lambeth Art Pottery." By John Sparkes.

March 17.—"The History of the Art of Book-binding." By Henry B. Wheatley, F.S.A.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

Section of Applied Chemistry and Physics.

Thursday Evenings, at eight o'clock:—

January 22.—"The Teaching of Technical Physics." By John Perry, late Professor of Engineering, Japan.

February 12.—"Gas Furnaces and Kilns for Burning Pottery." By Herbert Guthrie, C.E.

April 8.—"On Recent Improvements in Benzine Colours." By F. J. Feiswell, F.C.S.

May 13.—"On some Physical Applications of Light." By Prof. W. G. Adams, F.R.S.

Indian Section.

Friday Evenings, at Eight o'clock:—

January 30.—"Herat." By Colonel G. B. Malleson, C.S.I. Admiral Selwyn will preside.

February 20.—

March 5.—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.P.C.A., Superintendent of the Government Farms in the Madras Presidency.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

February 3.—"Social and Commercial Prospects in the Transvaal." By the Rev. G. Blencowe (late of the Transvaal and Natal). Sir Theophilus Shepstone, K.C.M.G., will preside.

February 24.—"Views of Colonization." By William Forster, of New South Wales.

March 16.—"Iceland and its Resources." By C. G. W. Lock.

April 6—"Art in Japan." By C. Pfoundes. Sir Rutherford Alcock, K.C.B., will preside.

April 27.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. James Sibree, jun., F.R.G.S.

Cantor Lectures.

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by Thomas Bolas, F.C.S., will be delivered on Mondays, February 2, 9, 17, 23; March 1, 8.

Lecture I.—February 2.

Sources of India-rubber. Chemical and physical properties. Behaviour with chemical reagents. Action of various solvents. Effects of heat, cold, aud light.

Lecture II.—February 9.

Mechanical and chemical purification. Working of unvulcanised caoutchouc. Formation of blocks, sheets, and threads. Elastic webbing. Other uses of unvulcanised India-rubber.

Lecture III.—February 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

Lecture IV.—February 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

Lecture V.—March 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

Lecture VI.—March 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

MEETINGS FOR THE ENSUING WEEK.

Monday, Jan. 19th...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. W. L. Huskinson, "The Present Depression in English Agriculture; its Real and Assumed Causes."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Rev. J. Fisher, "The Organ of Mind."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. J. E. H. Gordon, "The Leyden Jar."

Tuesday, Jan. 20th...Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. A. Schäfer, "Physiology of Muscle." (Lecture II.)
Civil Engineers, 25, Great George-street, Westminster, W., 8½ p.m. 1. Mr. L. F. Vernon Harcourt, "Fixed and Movable Wears." 2. Mr. R. B. Buckley, "Movable Dams in Indian Wears."
Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Mr. G. Phillips Bevan, "The Strikes of the Past Ten Years."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
Royal Colonial, "Pall Mall," 14, Regent-street, S.W., 8 p.m. Mr. J. G. Bourinot, "The National Development of Canada."

Wednesday, Jan. 21st...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Henry Carr, "Domestic Poisons."
Meteorological, 25, Great George-street, S.W., 7 p.m. Annual Meeting.
Geological, Burlington-house, W., 8 p.m. 1. Mr. J. W. Davis, "The Genus *Pleuracanthus*, Agass., including the Genera *Orthacanthus*, Agass. and Goldf., *Diplodus*, Agass. and *Xenacanthus*, Beyr." 2. Mr. Frank Rutley, "The Schistose Volcanic Rocks occurring on the West of Dartmoor, with some Notes on the Structure of the Brent Tor Volcano." 3. Mr. E. B. Poulton, "Mammalian Remains and Tree-Trunks in Quaternary Sands at Reading."
Entomological, 11, Chandos-street, W., 7 p.m. Annual Meeting.
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. H. W. Cope, "Ancient Jade Instruments." 2. Mr. W. De Grey Birch, "Ancient and Unpublished Documents."

Thursday, Jan. 22nd...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Section of Applied Chemistry and Physics.) Prof. Perry, "The Teaching of Technical Physics."
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. W. E. Ayrton, "The 100,000th of a Second."
Society for the Encouragement of Fine Arts, 8 p.m. Conversazione at the Galleries of the Society of British Artists, Suffolk-street, Pall-mall East, S.W.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. H. Statham, "Modern Architecture since the Renaissance." (Lecture II.)
Inventors' Institute, 4, St. Martin's place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. A. T. Walmsley, "The Bridges of the Thames at London."

Friday, Jan. 23rd....Royal Institution, Albemarle-street, W., 9 p.m. Dr. W. B. Carpenter, "Sea and Land in Relation to Geological Time."
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
New Shakespeare, University College, W.C., 8 p.m. 1. Mr. Edward Rose, "The Inconsistency of the Time of Shakespeare's Plays." 2. Mr. W. J. Rolfe, "Is there a 5th Day in 'Romeo and Juliet?'" 3. Mr. Hermann Linde, "There is not a month between Scenes ii. and iii. of 'Julius Cæsar,' Act I."

Saturday, Jan. 24th...Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Dr. O. J. Lodge, "The Theory of Prof. Hughes' Induction Balance." 2. Mr. C. V. Bays, "A Liquid Voltaic Arc." 3. Mr. J. Faber, "A Talking Machine."
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albermarle-street, W., 3 p.m. Prof. T. Rupert Jones, "Coal." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

UNION OF INSTITUTIONS.

The following Institution has been received into Union since the last announcement :—

School of Science, Liverpool.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF BREAD-MAKING.

By Professor Graham, D.Sc.

LECTURE V.—DELIVERED DECEMBER 22ND, 1879.

At last we have got our loaf in the oven, and it will remain in the oven about an hour and a half. While it is in there, I propose, in the first place, to consider some peculiarities in ovens, and then to discuss that part of the subject which comes most within my province, namely, the chemical changes produced by the action of heat on the loaf. In the common oven, in former times, and even yet to some extent abroad, the heat was obtained by burning wood inside the oven; that is to say, in that part of the oven in which the bread was afterwards placed. When the combustion of the wood had communicated a sufficient amount of heat to the walls of the oven, then the embers were taken out and the bread was put in. This is manifestly a rather cumbersome method, and I need hardly say, in a country like ours, is also an expensive one. Consequently, even long ago, coal was employed for the purpose of heating the oven, the coal being used in external furnaces. The Vienna baker, who certainly for many long years has been pre-eminently the best baker in Europe, and from whom the Parisian has learned much, years ago found out that steam, acting on the moist surface of the loaf, was able, at the high temperature of the oven, to convert the starchy matter of the surface, moistened, as I said before, with water, into dextrin; in other words, by the action of heat and moisture, he found that he could convert starch into dextrin in much the same way that the greater part of the dextrin, which is now used in calico printing, or at the back of postage stamps, is also made. The Vienna baker obtains the steam in this way. The first batch of bread is common bread, of rather an inferior character, and of course in baking that bread the oven is charged with the moisture of the steam which comes from the bread. After that the rolls, moistened on the surface with water, being placed in the oven, the steam from the first batch of bread causes this glazing of the surface. Of late years the Parisian bakers have employed steam-boilers, so that an injection of steam, from a boiler working under a little pressure, takes place into the oven, and such ovens, though they are not common, can be found in several places in London. I have a drawing here of an oven which will give you an idea of the character of the operation that goes on. The centre drawing represents the front of the oven as you see it with the door for the admission of bread, and a door underneath for warming up rolls and loaves previous to their introduction into the oven. On the side is the boiler with the steam gauge. You will notice the drawing has two lines indicating an intersection, at A B and C D. The drawing on the left is the section at A B, and shows the interior of the oven. The door is partially open, and there is a pipe at the side, with small apertures for the purpose of charging the oven with steam. You will notice that the floor of the oven is not horizontal, but rises slightly, the object being that when the the door is opened the steam shall not fall out. Being heated, it is lighter than air, and if there is a slight incline given to the floor of the oven, the tendency of the steam is to keep in; whereas, if it is flat, there is a tendency for a considerable quantity of the steam to pass out every time the door is opened and shut. The other drawing represents a section on the line C. D., which indicates, by means of a moveable door, the way in which the flame coming from the furnace is sent into the oven in order to heat its stone walls. So soon as the oven has arrived at a temperature of about 400° to 450°, it is closed. In the bakeries of Mr. Bonthron, of Regent-street, and Mr. Carl Fleck, of the Brompton-road, a plan is adopted of having two ovens, side by side, so as to economise the fuel to some extent. I have not examined other ovens, but I know that besides these there are some other bakers in London who also adopt this injection method, which practically, in its first conception, was due to the Austrian baker.

In addition to this system of baking bread by means of fuel, steam has also been employed in other processes; what is called Neville's bread, which has a considerable sale in London, I understand, is baked by means of steam at a high temperature. You, doubtless, know the character of that bread sufficiently well, and it is, therefore, not necessary that I should further allude to it.

I will pass on now to the chemical examination of the changes which take place when the bread is introduced into the oven. In the first place, the bottom of the loaf, and the side and the top of the loaf, are greatly heated by the hot surface which comes in contact with the bottom, and by the hot surfaces, which radiate the heat from the top of the oven on to the loaf. You will notice, in looking at the drawing, that the depth of the oven is comparatively slight, the object being to have the radiating surface as near as possible to the top of the loaf. So soon as the loaf has

been submitted to the action of the heat, the carbonic acid gas which was in the dough expands, and by the time that gas has been heated from about 80° to 212°, which is the boiling point of water, that gas will have expanded from 1 cubic inch to 1·24, and that will indicate the amount of increase that a loaf would undergo, supposing there was no moisture. But while that amount of increase takes place, due to the expansion of the carbonic acid gas itself, there is also considerable expansion due to the fact that the gas is moist. Now, the tension of aqueous vapour at 212° is equal to the atmospheric pressure, and therefore we get an enormous increase, due to the amount of the moisture, as well as to the carbonic acid gas itself. I said just now that the temperature of the oven ranged from about 400° to 450°. The temperature of boiling water is 212°, that is to say, provided the barometer stands at 30 inches of mercury, because, of course, there is a higher boiling point if the barometer be higher, and lower if the barometer should stand lower. Therefore, although the walls of the ovens are at a temperature of about 400° to 450°, the loaf itself is not at such a temperature. The bottom, which is resting on the hot surface, of course is considerably heated, but the interior of the loaf does not rise much above 212°. It rises doubtless slightly above that temperature, due to the resisting action of the outer surface of the crust, which adds to the resistance of the atmospheric pressure. Secondly, during this action which is going on in the presence of moisture, the cell walls of the starch are ruptured, so that we obtain from such a heating action, not starch such as we know it before it is boiled, but starch which, by the ruptured cells, lends itself readily to the action of albuminoid ferments. Thirdly, by the action of heat, some of the albuminous matter undergoes a degrading action, which is afterwards of use in the digestion process. But that is not all. Due to the action of heat and moisture, not only is there glazing by the production of dextrin on the surface, but there is also, to a slight extent, a production of dextrin in the interior of the loaf. You all know that if you were to boil a suet dumpling, for example, for a comparatively short time, the suet dumpling would not be very remarkable for its digestibility. Indeed, as in a day or two the most favoured festival of our year will be at hand, I am reminded, by this action of the heat upon the dumpling, of the old doggrel, which I should imagine was partly composed by youth and partly by the experience of old age. That doggrel says, "Plum pudding hot, plum pudding cold." That represents, to a great extent, the desire of youth to have plum pudding, no matter whether it be hot or cold, provided there be plenty of it. But, then, old age lays down this as a necessary condition, that the plum pudding should be "in the pot nine days old;" in other words, you cannot get digestible albuminoids and starch of wheat unless they have been submitted to the prolonged action of heat and moisture, and this, to some extent, takes place in the action of heat upon the loaf in the oven.

Another point I have to notice is, that coloured products are formed. I have a table on the wall,* prepared by Oudemans, showing the action of heat on malt, and you will see there that air-dried malt contains no torrefaction products, and that there are no less than 13·6 per cent. of albuminoid matters; whereas, when the malt is heated to a temperature less than the boiling point, we get 14 per cent., of torrefaction products, and only 10·5 of albuminous matter. The torrefaction or coloured products that are formed, are partly due to the action of moisture at a high temperature on soluble albuminoid matters, and partly to the dextrin and maltose sugars that have been formed in the previous panification process. Now, the more soluble products are obtained in the previous process of bread-making, the greater will be amount of colour in the final loaf. On the other hand, the less the soluble products produced by the previous bread-making process, the less will be the coloured products obtained in the oven. That is why inferior flours produce so much colour. Inferior flours, as I pointed out to you from the tables drawn up by Mr. Brown, yield to the panification process, that is, in the process where moist and moderate heat is acting on flour for a considerable time, a very large quantity of soluble products are formed. Therefore, I say that the more soluble products obtained in the previous panification process, the greater the amount of coloured products obtained in the oven, and of course the less pleasant does the loaf look.

Another matter we ought to notice is, that by the action of heat we obtain the outside crust. This crust retains the moisture for a much longer time than if there were no crust, and, lastly, the amount of moisture or water is greater the finer the flour, and, of course, *vice versa*, and this absorption and retention of water depends upon two distinct factors. In the first place, it depends upon the higher character of the albuminoids. Albuminoids of high maturation character (such as the crude gluten, which, you will remember, I told you was composed chiefly of fibrin, and, to some extent, also of glutin) absorb and retain water with great avidity, which is not the case with some other forms of albuminoids, such as albumin found in most cereals, found largely in our inferior wheats in bad seasons, but to a very small extent in really well-matured wheats grown in highly favoured climates; the legumin and other soluble albuminoid bodies, found very largely in the *leguminosæ;* and the cerealin, which is one of the albuminoids found in the husks of cereals—of wheat especially—these soluble albuminoids do not absorb much water, nor have they much power in retaining it. Therefore, I say, that the first factor depends on the character of the albuminoids present. But there is still another, which is this, it depends also on the per-centage of starch. Supposing you have a sufficiently large quantity of the hard gluten, then the higher the amount of starch, the more water will be absorbed and retained by such flour.

This absorption, and retention of water enters largely into the question of the number of loaves that may be obtained from 100 lbs. of flour. The baker, of course, reckons by the sack, but it is more convenient to take a per-centage result. According to Lawes and Gilbert, in 100 lbs. of bread, there will be on the average 62·8 of dry solid matter, and 37·2 of water; according to Millon, 63·7 of dry matter, and 36·3 of water;

* See Table on p. 128, *Journal*, January 16.

according to Dumas, 55·4 of dry matter, and 44·6 of water; according to Maclagan, who made a series of researches on this matter, the average amount of dry matter was 64, and of water 36. From a number of results supplied to me by many bakers, I find the average agrees pretty well with the statements of Lawes and Gilbert. To take this question from another point of view, 100 lbs. of flour will yield, according to Lawes and Gilbert, 135 lbs. of bread; according to Dumas, 130; and Maclagan, 137·7. But I need hardly say that the number of loaves obtained from 100 lbs. of wheat flour, or the number of loaves obtained from the sack, will, of course, vary according to the character of the wheat. Practically, the finer the wheat, the greater number of loaves obtained from it. It may be of interest—not to those practically acquainted with the matter, but to those who are not—to say that the number of loaves obtained from a sack of flour will vary—I am afraid, in a year like this with English wheats, the results would be rather low; but, taking more favoured circumstances, it will vary—from 90 to 94; possibly, with exceedingly fine foreign wheats, more than the latter number may be obtained.

I have now done with the fermentation process, by which carbonic acid gas (I have said very little about the alcohol which is produced, as I pointed out, along with carbonic acid gas in the fermentation process) is used for the purpose of lightening the bread. I have now to refer briefly to what may be called artificial processes of producing the same evolution of carbonic acid gas, not from the flour, but from chemical substances used along with the flour. The best known of these methods is the process of Dauglish, which is still practised in London, and it may be in some other large towns of England. The carbonic acid gas in this method is obtained by the action of acid upon chalk, that is, carbonate of lime. The carbonic acid obtained by the decomposition of chalk is thoroughly well washed, and the carbonic acid and water are then mixed, in proper proportions, with the flour, and, as rapidly as possible, the dough is made, scaled, made up into loaves, and put into the oven. Now, the advantages of these artificial processes are manifest. An inferior flour is not submitted to the degrading action of the albuminoids upon the starch; we obtain no sugars, we obtain no dextrin. In other words, no action takes place, except in the oven, and, therefore, one is able to employ inferior flours by such an artificial process. I referred to this process at our last meeting, and a gentleman asked me at the end of the lecture whether I meant that those who employed the Dauglish process used inferior flours. Of course I did not say that, nor do I say it. I merely say that one of the advantages of the invention or suggestion of Dr. Dauglish is, that we *can* make use of inferior flours. Another advantage is, that the process is a very rapid one. The whole making of bread occupies a very small period of time compared with the long, tedious, laborious operations of the ordinary fermentation plan. On the other hand, I think I am bound to mention (though this is not so much a scientific matter as one of personal opinion) what I consider the disadvantage of the process. Such a bread is manifestly less sweet than if the flour had been subjected to the fermentation process. There has been no dextrin, no sugar formed, and the albuminoids have not been lowered or degraded. Consequently, such a bread does not taste sweet; it has none of that nutty flavour, according to my taste, which a well-fermented good loaf has; and it seems to me that many other people at least must have adopted the same opinion, because it is long since Dr. Dauglish proposed this method, which theoretically seems a very excellent one, and yet, I think I am not very wrong in saying that, if we consider Europe, we shall find that a remarkably small portion of the flour of Europe is submitted to the Dauglish method, compared to the vast amount of bread made by the fermentation process; and if the bread had been so well thought of by the world at large, it ought by this time to have progressed much more than it has. Another objection which occurs to me here is this, that the bread cannot be so rapidly digested as the fermented bread; and it would be desirable that investigation should be made upon this point, because one cannot help feeling interested in the Dauglish process, on account of certain obvious merits which it has.

Other methods for producing artificial raising of bread are very numerous, and I need only name two or three of them. In the first place, there is the process by which bicarbonate of soda and hydrochloric or muriatic acid, are brought to act on each other in the dough. A reaction takes place, by which chloride of sodium, or common salt, is formed, and the carbonic acid escapes, and, therefore, raises the loaf. But it is necessary that the operation should be carried on very rapidly, and it is also necessary that the exact proportions of bicarbonate of soda and hydrochloric acid should be used, so that there should be an exact neutralisation of one by the other. In addition to this method, tartaric acid and bicarbonate of soda are employed occasionally; and sometimes hydrochloric acid, to which a small quantity of the acid phosphate of lime has been added, is also employed, along with the bicarbonate of soda. It is very easy to make this acid phosphate of lime. If you take a small portion of burnt bones, called bone ash, which comes so largely from the River Plate and the Rio Grande in South America, and add to it hydrochloric acid, you convert it into what is technically termed superphosphate of lime, or acid phosphate of lime, and if you use an excess of hydrochloric acid, you will have a solution of acid phosphate of lime in the hydrocloric acid liquid, and this, if it be used to react on the bicarbonate of soda, will give common salt, together with phosphate of lime. The use of such agents has been recommended by many, owing to the desire, especially in the case of poor children, ill supplied with milk, that the bread should contain bone earth, or the elements of bone earth, so that the children may obtain a considerable quantity of phosphate for the purpose of building up their bone tissue which, at an early age, is so necessary. Bicarbonate of ammonia has also been employed as an artificial method of raising bread, and, of course, there are many other such artificial chemical means. The various baking powders which are so much advertised, depend on a reaction of this kind by which carbonic acid gas is employed artificially. They all of them seem to me to be open to the same

objection as the Dauglish method, and they have not its advantages, except in so far that they enable one to make an aërated bread under certain unfavourable circumstances, such as at sea, or far away from the means of obtaining yeast; of course, under these conditions, they have some value.

Our bread being made, the next point one has to consider is, how it is digested. Now, digestion is a continuance of fermentation. Of course, I am using the expression fermentation in the same sense that I used it in speaking of the hydration action upon starch. I am not using the term now in the sense of the boiling fermentation, where carbonic acid and alcohol are produced, but that form in which water is added to the molecular structure of the starch, and by which sugars and dextrin are formed. The first agent which is brought to bear upon the bread is the albuminoid ferment, called by physiologists, *ptyaline*, which is found in the saliva. In order to obtain a thorough and rapid hydration of the starch, so that that starch is converted into soluble bodies, sugars and dextrin, it is necessary that the bread should be thoroughly comminuted, and we are endowed with a very wonderful apparatus for the purpose of cutting and grinding it up into a fine porous mass. At the same time, while this operation is going on, the grinding action stimulates the glands, so that during the time they pour out the secretion destined by Nature for the solution of these starchy bodies. Of course two points have here to be considered. I said we must obtain a fine, light porous mass, and we must, therefore, so cut up or grind that bread that it should always remain a fine porous mass; that it should be thoroughly aërated, and at the same time well mixed with this albuminoid ferment of the saliva. Manifestly, therefore, we see at once that the habit, which is so common in England, of eating hot rolls and new bread, is the very opposite of what nature has pointed out should be done. Bread which, when you press it between your finger and thumb forms into impervious balls, is not a bread which lends itself readily to the action I am speaking of; and I have been told, on good authority, that bakers, who have found out for themselves so many very interesting scientific facts connected with the whole process of panification, seldom eat new bread. Indeed, one gentlemen said they never did; they wait, at any rate until the second day, until it will, in the grinding action, remain light and porous for the action of the *ptyaline* upon it.

Mr. Lewis has kindly heated two tubes. In my right hand, I hold a tube which contains a solution of bread, made simply by breaking it up to a fine powder, and then digesting it for two hours at a temperature of 100° Fahr. It was then filtered; nothing but water was added to the bread, and he has added some of Fehling's liquid and has boiled it. You see that there has been no reduction, or, at any rate, a very small reduction of the protoxide of copper to the suboxide. Whereas, in the other tube, the bread was comminuted into the fine condition in which it should be, as was also done in the other case, and it was then mixed with a little saliva obtained by exciting the submaxillary gland. This was warmed also, at about 90° to 100° Fahr., for about two hours, and you see the amount of sugar that has been formed. Where the saliva has been mixed with the bread, it has produced a considerable quantity of sugar. So far for the sugar. On the addition of a little alcohol, we shall be able also to see a considerable difference in the total amount of products which have been rendered soluble under the two conditions. The right-hand tube was the one submitted to the action of the saliva, and the left-hand one exhibits simply the action of water on the bread. There is in the one case a considerable precipitate, and in the other very much less. I will also show you the amount of albuminoids which have been rendered soluble in the same time. While Mr. Lewis is doing that, I will make a few remarks on the necessity for all of us to husband this valuable fluid. It is not given to us to throw away, and those of you who are just about to begin manhood's life, I should certainly recommend, if possible, not to adopt the habit of smoking. But still, if you should smoke—and I do not suppose anything I may say will prevent you—I should recommend you to learn the way in which a German smokes. Any average German will smoke from morning to night, from the beginning of the year to the end, and will not expectorate once; he learns the habit of smoking without expectorating, and the result is he is none the worse for his smoking—at least one does not see it; whereas we, in England, with our short pipes, smoke tobacco loaded with moisture—which is one of those delusions about pipe tobacco which has arisen, probably, from the interest of tobacconists. You know most people have the tobacco loaded with moisture, and keep it in a jar with a leaden cover to it. Thus considerable quantities of unburnt nicotine distil over with the moisture, and also, at the same time, tarry products and creosote; whereas, when the tobacco is dry, a comparatively small quantity of these distil over into the mouth, and, therefore, there is no necessity to expectorate. In these tubes you have, on the left hand side, the solution which has been acted upon by some ferrocyanide of potassium and acetic acid, and that has thrown down most of the albuminoid matters. The one on the left hand side is the solution of bread simply with water, the other on the right hand, of course, has had saliva added to it. In the left tube you see there is no precipitate, or an excessively small quantity of albuminoid matters; whereas, in the right-hand tube—due to the saliva—we have an abundant precipitate of albuminous matter. We see, therefore, that this valuable fermenting principle which we have at the very threshold of digestion, is able to convert boiled starch into sugar and dextrin with considerable rapidity, and at the same time also it breaks down, and therefore dissolves, some of the albuminoids. It then passes downwards, and in the stomach and duodenum it meets with other fluids, some of which have the power also of hydrating and converting starch into sugar and dextrin, and some others have the power of dissolving the albuminoids themselves. In that way we obtain the perfect solution of the bread that we eat.

I pass on now to a very interesting matter, and that is the value of bread as food, or its value as a source of power. I have here a table which we owe to the researches of Messrs. Lawes and Gilbert, showing the composition of the ordinary articles of food—meat, bacon, butter, milk, cheese, flour,

bread, maize, oatmeal, rice, potatoes, vegetables, peas, and sugar.

Average Composition of Articles of Food.
(*Lawes and Gilbert.*)

	Parts per 100.			
	Dry Substance.	Carbon.	Nitrogen.	Nitrogen to 100 Carbon.
Meat	45	30	2·0	6·6
Bacon	80	57	1·1	2·0
Butter.....	85	68	..	..
Milk	10	5·4	0·5	9·3
Cheese	60	36	4·5	12·5
Flour	85	38	1 7	4·5
Bread	64	28·5	1·3	4·5
Maize	87	40	1·7	4·4
Oatmeal	85	40	2·0	5·0
Rice.....	87	39	1·0	2·5
Potatoes	25	11	0·3	3·5
Vegetables	15	6	0·2	3·3
Peas	85	39	3·6	9·4
Sugar	95	40	..	..

I will not, of course, detain you by reading all these numbers, but I wish to point out to you some very interesting results obtained from a consideration of these researches. We find in the fourth column a series of numbers headed, "Ratio of nitrogen to 100 parts of carbon." In the case of wheat, it is 6·6; bacon, 2; of course in butter none; milk, 9·3; cheese, 12½; flour, 4½; of course bread is the same; rice, 2½; ordinary vegetables, 3·3; and so on. In sugar there is no nitrogen. In looking at this table, you will see that flour and bread stand tolerably high in the ratio of nitrogen to carbon, viz., 4½ to the 100. This leads me back again to a matter I spoke of before, viz., the question of what one should do with the bran of the wheat. Supposing a hard-working labourer, say a ditcher or a navvy, were supplied with white bread almost in sufficiency, but yet not quite, what would he crave for? We all know, as a matter of fact and experience, and those of you who have seen men undergoing hard mechanical work will agree with me, his first craving is not for a lump of brown bread, but for a piece of fat, butter, or bacon; but in any case the craving is not for more nitrogen, but for more carbon, and especially if that carbon be derived, not from the carbo-hydrates in which, as I pointed out to you, the hydrogen and oxygen are in the ratio in which they form water, but bodies such as fat, in which there is a very small proportion of oxygen, and, therefore, a considerable excess of hydrogen; in other words, bodies which contain, not merely respirable carbon, but also respirable hydrogen, that is, hydrogen over and above that which is required to form water with the oxygen in the compound. That is what a man craves for. If the labourer were to select cheese instead of fat, even then, in cheese, there is a considerable quantity of fat, and from the fat of the cheese he would obtain a considerable amount of heat force, vastly more than he would from the caseine of the cheese. But, probably, what the great mass of working men undergoing hard work would desire most to have, would be very fat meat. Those of you who may have seen navvies consuming large quantities of excessively fat bacon, so fat that one can see no lean in it, will readily understand what I am pointing out. And yet there is a very current notion that it is the lean of the meat that gives us the greatest amount of motive force—the greatest amount of mechanical power; whereas, not only will a labourer in our own country, but the Chinese coolie, who lives upon rice, when he has to do a large amount of work, such as loading a ship (and it is astonishing the enormous quantity of work they can do under pressure) does not look to albuminoids in order to give him that extra power; on the contrary, he uses butter or fat with his rice. He uses those fatty compounds that contain carbon, and contain what chemists would call potential force in the hydrogen, over and above what is required to form water with the oxygen in the compound.

Let us see if science cannot explain this difference of opinion. We have the instinctive craving of the labouring classes throughout the world; and we have certain views, which have been accepted, that lean meat, or albuminoids, are the best sources of motive power. Before coming to the table, which I have here, on the mechanical equivalent of food, I think it will be convenient if I explain to you a few numbers that are necessary to be understood before we can consider these sources of power. According to the definition used by physicists, we say that a unit of heat is the amount of heat required to raise a gramme (= 15·432 grains) of water 1° Cent.

If you take one gramme of pure carbon—say, the very finest charcoal—and thoroughly burn it to carbonic acid gas, the amount of heat given out by that oxidation of one gramme of carbon would be sufficient to raise 8,080 grammes of water 1° Cent. I must apologise for using French weights and measures, but I am very much more conversant with these data in the French than in English weights and measures; but I will afterwards put the statements in a plainer form, so that you will be better able to follow me. Now, hydrogen gives out rather more than four times as much heat as carbon. One gramme will give out as much heat, when converted into water by burning, as to raise 34,462 grammes of water 1° Cent.; that is, merely considering the amount of heat-force obtained from the oxidation of carbon and hydrogen, and looking at it solely from the point of view of how much water that oxidation will warm. In order to convert this into the mechanical motion of lifting a weight against gravity, all we have to do is to make use of the data obtained by the most invaluable researches of Dr. Joule, of Manchester, published some years ago, by which he determined what is called the mechanical equivalent of heat. He found, when a gramme weight was allowed to fall through 424 metres, the force thus generated being made—by proper mechanical contrivance—to agitate water, that an amount of heat was produced equal to raising the temperature of the same weight of water—that is, one gramme—1° Cent. The force obtained from a falling weight can be converted into heat-force, and, conversely, the heat of combustion can be converted into raising a weight against gravity. Thus, a gramme

of carbon, when burnt to carbonic acid gas, produces 8,080 units of heat, and is, therefore, equivato 8,080 × 424=3,392 mètre kilogrammes of work, or rather more than the force produced by three tons falling through one mètre. The same weight of hydrogen, when burnt, produces more than four times as much force as carbon, and is equivalent to 14½ tons falling through one mètre.

Now, these data being explained, I will proceed to consider the motive force obtained from the various sources of food we make use of, and, thanks to the researches of Voit, Pettenkoffer, Bischoff, and others abroad, and Playfair, Edward Smith, Frankland, and others in our own country, this matter has been made very clear. In the experiments of Frankland, by which he determined, by very well-known methods, the heat of combustion, not merely of carbon and hydrogen—that had been done before—but the heat of combustion of lean meat—that is say, meat deprived of fat by digestion in ether—fat meat, rice, potatoes, starch, and so on, he found that the heat of

Mechanical Equivalent of Food. (*In natural state as consumed.*)

Weight of substance One gramme (= 15·432 grains.)	Complete oxidation.		As burnt in body.
	Units of Heat.	Mètre kilogrammes of Forces.	Mètre kilogrammes of Forces.
Potatoes	1·013	429	422
Flour	3·936	1669	1627
Oatmeal	4·000	1696	1665
Rice	3·813	1615	1591
Lean of beef	1·567	664	604
Beef fat	9·069	3841	3841
Cheshire cheese	4·647	1969	1846

combustion of fat was rather more than six times that obtained from the same weight of lean. I am not using the word "lean" in the sense that you and I do, where we speak of a lean beefsteak as having no fat in it—a lean beefsteak contains a good deal of fat—but the lean meat deprived of fat by proper chemical means. He found that fat can develop more than six times as much heat as the same weight of lean. Now, Dr. Frankland, in carrying out these researches, determined not merely the absolute amount of heat-force obtained, but the amount of force obtained by carbohydrates, from fat, and from albuminoid matters, when used by man. Albuminoids are not burnt up to carbonic acid and ammonia; they are eliminated chiefly as urea, slightly as uric acid, and, in birds and reptiles particularly, a considerable quantity is eliminated in the less oxidised form of uric acid. By making a deduction from these determinations of the eliminated urea, the result of his researches was that the fats yielded a very large amount of force compared with the albuminoids—as I said before, about six times as much. Two German chemists—Messrs. Fick and Wislécenus—experimented upon this matter. They carefully and most accurately weighed everything they ate, and accurately determined the excrete products, the carbonic acid, and so on. They found that, in going up the Faulhorn, which is 10,000 feet high, they burnt 37 grammes of their muscles. Now, according to the researches of Frankland, this 37 grammes of muscle was only equivalent to 68,000 metre kilogrammes of force; whereas, the total amount of force expended in going up a mountain of that height was 319,000 metre kilogrammes—leaving a deficiency, therefore, of 251,000 metre kilogrammes. This was entirely due to the fat and the carbo-hydrates they consumed, and not due to the oxidation of their own muscles. From the researches of these gentlemen, and those of Playfair, upon labourers, and of Haughton, who experimented upon soldiers undergoing shot drill, and Dr. Edward Smith, who experimented not only upon individuals undergoing the treadmill, but who also worked the treadmill himself, and also from the work of Dr. Frankland, we now know that the heat of combustion we obtain, and the amount of force we generate, is due chiefly, not to the nitrogenous, but to the non-nitrogenous parts of our food.

This is not all. As the work done increases in severity, it is not the nitrogenous compound urea that increases, but it is the carbonic acid gas which increases in the eliminated products of combustion. The greater amount of work done in a given unit of time, the greater is the amount of carbonic acid produced. Dr. Smith, in experimenting upon himself, found that, when he was sleeping, he eliminated 19 grammes of carbonic acid gas per hour from his lungs. It was carefully quantified and weighed. When sitting, 29 grammes were eliminated; when walking two miles an hour, 79 grammes; three miles an hour, 100 grammes; when ascending the treadmill, at the rate of 28½ feet per second, it amounted to 190 grammes per hour. Then, you may say, granting that the carbonic acid increases the more work is done, whereas the urea increases but little, what function does the muscle perform in the system? The function that the muscle performs is precisely the same as the piston-rod, together with the machinery, play in the ordinary locomotive. You know that the function of the piston-rod of a locomotive is to convert the heat from the oxidation of the coke or coal—which, of course, operates in changing water into steam—into a motion of the mass; so that, in that way, by burning fuel, you can drive a train at 50 or 60 miles an hour. Precisely similar is the function of the muscle in the human system; it is the apparatus by which the heat produced from the oxidation of the carbo-hydrates and of the fat is converted into mechanical motion—into the motion, not merely of the pulsation of the heart and other internal mechanical work, but the motion of the body in walking, or running, or climbing hills, and other mechanical work. There is this difference, however, between the muscle and the piston-rod; not merely the piston-rod, but all the parts of the engine are carefully constructed by the engineer, so as to avoid what is technically termed "hot bearings;" in other words, there must be no local production of heat by friction in any part of the engine. There is this difference, then, that the muscle is partly oxidised and broken up, but the amount of heat obtained from the oxidation of the muscle is only converted into mechanical motion in about the ratio of one-third of the total heat produced, two-thirds going to heat the body, and only one-third going to pro-

duce mechanical motion. We are indebted for these researches to Heidenheim and others.

To take a more practical view of this question, one that will be more readily understood by most of you, I will take some of Dr. Frankland's results upon the heat of combustion produced by oxidising various articles of food. Supposing we were to take the average of all persons present in this room, and assume we are all 10 stone weight (140 lbs.), and if we wished to go up 10,000 feet against gravity, what amount of force should we require? I could have given you the quantity in mètre kilogrammes of force, as I have already done, but let us see what amount of money it would cost in the form of different kinds of food, in order to do that amount of mechanical work.

Weight and Cost of Food required to raise 140 *lbs.* 10,000 *feet high.*

	Weight in lbs. required.	Cost per lb. in pence.	Total cost in pence.
Potatoes	5	1	5
Flour	$1\frac{1}{3}$	3	4
Bread	$2\frac{1}{3}$	2	$4\frac{3}{4}$
Oatmeal	$1\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{2}$
Rice	$1\frac{1}{3}$	4	$5\frac{1}{2}$
Lean of Beef	$3\frac{1}{2}$	12	42
Beef Fat	$\frac{1}{2}$	10	5
Cheshire Cheese	$1\frac{1}{5}$	10	12

On this table we have the number of lbs. required, of different kinds of ordinary food, to produce this amount of mechanical work. If we take potatoes; we find 5 lbs. of potatoes would be required, and if we consider them as costing 1d. per lb., it will cost 5d. You will readily understand that the last column, which gives the value of the articles, will vary from time to time. Of flour we should only require $1\frac{1}{3}$ lb., which is taken at about 3d. per lb., and this would, therefore, only cost 4d. Bread would cost $4\frac{3}{4}$d.; the difference is due, doubtless, to the expense of the process of making bread. In the case of lean beef, deprived of fat, $3\frac{1}{2}$ lbs. are required; and, as the cost of very lean beef is taken at 1s. per lb., that would cost 3s. 6d., whereas the fat would only cost 5d., because so small a quantity as $\frac{1}{2}$ lb. would do the work which $3\frac{1}{2}$ lbs. of lean beef would do; $1\frac{1}{5}$ lb. of Cheshire cheese would be required, which, assuming the price to be 10d. per lb., would cost 1s. to do that amount of mechanical work. Of course, this table is merely suggestive, but you see perfectly well that man does not require a large quantity of albuminoids in doing heavy work.

I told you that bread contains a very fair ratio of nitrogen to carbon, and that, when considered from another point of view—the mechanical work capable of being done by the use of such food materials—that, really, the money spent upon flour is not at all badly laid out; whereas, on the other hand, if you wish to have a large quantity of work done in a short time, then, in addition to bread, we require, not to use much nitrogenous matter, but rather to use fat, and, therefore, the peasants, not merely of England, but of all countries have been right, in spite of many scientific assertions that they were wrong, in their instinctive habit of adding fat, rather than nitrogenous food, to their diet when undergoing hard work.

At a former meeting, I said I would again revert to the subject of bran; in doing so now, I wish it to be distinctly understood that, in my criticism against the admixture of bran with flour, I have been anxious to defend the miller from the charges of being ignorant of true scientific principles. I hold that the miller who so well mills his flour as to eliminate all bran is the man who is working on true scientific principles. His object is to enable the baker to produce a fine, well-piled loaf, not a sodden, heavy one. I think it is right I should suggest a method by which wheaten flour may be used, and yet not produce the injurious effects which I told you finely-ground bran, with its cerealin, produces in the panification process. This is to do what I suggested at the last meeting should be done with inferior flours, namely, to make the ferment and the sponge of really good, strong flour, and then, in the dough process, when it is so much stiffer, and where the whole operation only lasts one hour, to use the wheaten flour. Of course, you are perfectly well aware that hydrochloric acid and bi-carbonate of soda are sometimes used for raising wheaten bread, but I am suggesting this other plan for those who prefer a fermented loaf, and yet wish to avoid the high-coloured products, and sodden bread, formed by the action of the finely-ground bran on this flour during the many hours of the ferment and sponge stages, and who desire that the fermented loaf of whole meal shall be light and porous.

I have, at last, come to the conclusion, and I will briefly recapitulate what, it seems to me, have been the prominent features of our study together. In the first place, you will remember, we studied in some detail the properties of the different constituents of the cereals, giving, of course, more especial weight to wheat. Secondly, we found that climatic conditions have a most important bearing upon the nature of those constituents; and then, thirdly, we considered together the right mode of treating such wheats by the miller, and, subsequently, by the baker. Lastly, we saw the necessity of microscopic examination of the yeast, in order to be sure that we were not introducing into our fermenting process organisms of disease producing acetic acid, lactic acid, butyric acid, and other injurious products. These, perhaps, have been the chief points, though, at the same time, there have been several others which have occupied our attention for some time.

I have now only to say that, if I have succeeded in awakening an interest in the wonderful phenomena connected with the art of bread-making, and have raised in your minds a true conception of the high importance and dignity of the art—based, as we have seen it to be, on some of the most interesting departments of physical, chemical, and biological science—and if I have stimulated any of you to resolve on the further study of these sciences, whereby greater and more rapid progress may be made, I shall rejoice that my efforts have not altogether failed.

The Chairman—Ladies and gentlemen,—Before you leave the room this evening, there is one duty which I am sure you will discharge with pleasure, and that is

to pass a very hearty vote of thanks to Dr. Graham for his lectures. There have been no occasions on which this usual compliment has been better deserved than the present. This is not the first time Dr. Graham has appeared in this room. Some years ago, he gave us a series of lectures on brewing, which, I think, is generally admitted to be one of the most important series of the Cantor lectures. Those of you who have attended the five lectures he has given us on bread-making, I think will agree with me they are not unworthy to take a place by the side of his former course. Dr. Graham is one of a small band of scientific men, who make it their special duty to enable our industrial workers to replace the old rules of thumb, which have so long dominated our industrial processes, by a knowledge of the principles on which those processes are founded. This he does at the great educational institution with which he is connected—University College—and this, I am happy to say, he has now, for the second time, done at the Society of Arts. I am sure you will all pass a very hearty vote of thanks to Dr. Graham for his very instructive and interesting course of lectures.

The motion was carried unanimously, and briefly acknowledged by Professor Graham.

SEVENTH ORDINARY MEETING.

Wednesday, January 21st, 1880; John Simon, Esq., C.B., D.C.L., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Barr, James, London-road Iron Works, Glasgow.
Bell, Henry, Guildford-street, York-road, Lambeth, S.E.
Berdoe, Walter, Silicate Paint Company, Charlton, S.E.
Bevan, James Oliver, M.A., Russell-house, Walmley, Birmingham.
Currie, William, Dalry-road, Edinburgh.
King, Arthur J., 53, Cannon-street, E.C.
Vernon, Walter L., London-road, St. Leonard's, Hastings, and 26, Great George-street, S.W.
Whitehead, Herbert Maguire, Conservative Club, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Baker, William Henry, 32, Vincent-square, S.W.
Christy, Thomas, F.L.S., 155, Fenchurch-street, E.C., and 64, Claverton-street, S.W.
Macnab, Henry Black, 1, Queen Victoria-street, E.C.
Mayne, Rear-Admiral, Richard C., 101, Queen's-gate, S.W.
Middleton, Reginald Empson, 5, Westminster-chambers, S.W.
Thuillier, Lieut.-General Sir H. L., R.A., C.S.I., F.R.S., 32, Cambridge-terrace, Hyde-park, W.
Ward, John H., Oakley-house, Caversham-hill, Reading.

The paper read was:—

"OUR DOMESTIC POISONS" IN RELATION TO TRADE AND ART.

By Henry Carr, M.Inst.C.E.

The object in view in this paper is to draw attention to certain poisonous materials, heedlessly introduced into, or intentionally used for some special purpose in, our domestic fabrics.

Accidental injurious emanations arising from defective construction of houses, foul air from drains, insalubrious sites, and such causes, would naturally fall under a distinct head, though involving, no doubt, domestic poisoning, in some cases, to a very serious extent. Attention will, therefore, now be limited to poisonous materials used in the process of manufacture and allowed to remain in the finished goods. The evil effects of these "domestic poisons" have long been known to a limited number, but they are only now beginning to be recognised by the public at large.

It should be stated that the writer has simply attempted to gather such information from competent authorities on medical, chemical, and trade questions, as may be useful when put forward in a collected form. As the question has been raised by a manufacturer, it should be here further stated that neither he nor any of his personal friends have any trade interest whatever in these matters.

The subject of domestic poisons naturally divides itself into two heads:—

First, as it affects the public, to whom these deleterious compounds are supplied.

Secondly, as it affects the trades, manufacturing and dealing in these articles.

The principal materials by which poisonous or injurious matters are introduced into domestic use, are arsenical pigments in wall-papers; arsenical dyes in cotton fabrics, such as curtains, chintz, tarlatane, &c.; in artists' water colours, and ordinary paint; in lithographic printing, poisonous colours being sometimes dusted on. Poisonous colours are also dusted on in colouring tin plate work. Poison is also introduced in artificial flowers, lamp shades, fly papers, in cardboard boxes and labels, now so much used by drapers, stationers, and confectioners; confectioners even attaching poisonous papers to sweets.

Fatal results are reported arising from the use of arsenic in destroying the nerve in teeth, but they appear to be very rare. Paper collars and cuffs are said to be sometimes arsenical, but all attempts to follow out these reports to their origin have hitherto failed.

The aniline dyes produced from coal tar are a source of very serious irritation in some cases, when brought into contact with susceptible skins. Lead is a well-known poisonous material, affecting water supply more especially, injurious also to the white lead manufacturers, to painters, and to many susceptible persons when exposed to newly-painted rooms.

The sanitary view of the question has been dealt with in the pamphlet, "Our Domestic Poisons,"* already published by the writer of this paper. Some further illustrative cases, however, under this head will be desirable before proceeding to the trade branch, which is the principal subject for consideration at the present time.

Amongst poisonous substances, the great offender, no doubt, is arsenic in its various combinations; for though aniline dyes free from arsenic produce most serious eruptive disorders, when imperfectly fixed or prepared, they do not affect the general health in the same insidious manner as arsenic. Aniline dyes do not produce injurious effects unless brought into contact with a susceptible skin, whereas the arsenical poison is diffused

* "Our Domestic Poisons," Ridgway, Piccadilly.

through the air either as dust or gas, so that injury may arise without actual contact with the arsenical fabric.

Those to whom this subject is new, have at first a difficulty in realising the fact that such small quantities of arsenic, combined in the colouring matter of a wall-paper or other fabric, can possibly have any injurious effect, since nothing but a chemical test will detect its presence. The evidence, however, which ought to satisfy any candid observer, will be found simple in the extreme, such as could leave no doubt on the mind of any unprejudiced person as to the verdict to be given.

The symptoms of chronic poisoning by arsenic begin with what appears to be an ordinary cold and cough; dryness and irritation of the throat and frequent headache; extreme restlessness; great debility, accompanied by cold clammy sweats, cramps of the legs, griping and dysentery, convulsive twitchings, and a group of nervous symptoms, varying in each case. Inflammation or irritation and smarting of the eyes and nostrils is often the most marked symptom, lasting for days, weeks, or months, sometimes accompanied by irritation of the skin or of the whole mucous tract; sore throat, running on to diphtheritic throat, ulceration and soreness of the mouth and tongue; irritative fever, which, if persistent, exhausts the patient, and death takes place by collapse. One universal feature should be mentioned, namely, the inefficacy of all usual remedies, the presence of arsenic not being suspected.

The above-mentioned symptoms are by no means absolute indications of arsenical poisoning; they may arise from other causes, but if the usual remedies fail to give relief there is reason for suspecting some hidden source of mischief. The proof of arsenical poisoning then depends on the patient's recovery on removal, relapse on return to the arsenical rooms, and final cure on discovery and removal of the arsenical fabric. There is no abstruse scientific investigation needed to obtain such evidence; the facts are plain, within the comprehension of the most ordinary common sense. Illness unaccounted for—failure of ordinary remedies—cure on removal—relapse on return—final cure on discovery and removal of the arsenical fabric.

Any number of cases might be produced illustrating the above position, but a few typical ones can alone be given here. The "nursery paper" now exhibited, with pictures of boys playing cricket, was the cause of the illness of four young children, relatives of the writer. Repeated illness at home, and recovery on removal from home, occurred during a length of time. One of the children died, exhibiting nearly all the symptoms above described as the results of exposure to arsenical fabrics. This occurred before the parents became aware of the injurious effects arising from this cause. After communication with the writer, the paper was taken down, and the surviving children recovered immediately.

The following is from Robert Brudenell Carter, F.R.C.S.Eng., Ophthalmic Surgeon to St. George's Hospital:—

"I have reason to believe that two children of mine died, many years ago, from an arsenical wall-paper in the nursery; but the presence of arsenic was not discovered until after the deaths had occurred."

Case of a lady residing on Sydenham-hill, as given by Rev. R. J. Simpson, who himself had previous experience in his own family:—

"In March last, Miss S—— moved into a furnished house. A few days after her arrival she was attacked with a slight cold and cough, and, being subject to bronchitis, she confined herself to her bedroom, where a large fire was continually kept up. She gradually became worse, and more unpleasant symptoms began to show themselves. She was constantly very sick and suffered much pain. There was a good deal of irritation about the throat and chest, accompanied with difficulty of breathing. The debility was great, and fainting fits of almost daily occurrence. A friend who remarked the suspiciously bright green paper on the wall of the bedroom, advised her to move into another room. This she did, after having occupied the room with the arsenical paper for six weeks. Each day after the change found her better, and she was soon restored to her ordinary health. I may mention that a Persian cat, which was always with her during her illness, was observed to be covered with a peculiar eruption, and her hair came off in large quantities."

It may here be observed that cats are frequently affected by arsenical papers, as mentioned in this case, and so are birds.

The following cases are furnished by Mr. Edmund Spitta, L.R.C.P., M.R.C.S.:—

"Case 1 was that of a little girl who had bronchitis. Convalescence occurred at the usual time, but was attended with extraordinary relapses of a severe nature. These relapses always came on after any circumstances which raised dust in the room. The wall-paper and the dust were examined by Dr. Stenhouse, and were all found to contain arsenic. The child rapidly recovered after removal to another room.

"Case 2 was that of a gentleman, who also had bronchitis, and who, like the child, always became much worse when his children ran about the room, or when, from other causes, dust was disturbed. Paper found to be loaded with arsenic. Recovered slowly after removal to another room.

"Case 3 occurred in a lady of weak constitution, who for years has had impaired health. She was suffering from great prostration, which steadily got worse. Alarming symptoms presented themselves, the patient fainting many times daily. Sweatings, vomitings, and dryness of the mouth, with intense prostration, almost closed her career. The wall-paper of the room, being examined, was found loaded with arsenic. With change of air she has now much improved; indeed, she is almost well.

"Case 4. My concluding case was simply one of depression, with pain in the stomach of the most obstinate character. Had the bedroom paper tested, and found the old enemy, the getting rid of which effected the recovery of the patient."

The following is the case of Mr. and Mrs. Clifton, of Derby, as reported by the former:—

"In March of the present year, 1879, I had my room papered, but did not occupy it for six weeks afterwards. A few days after sleeping in the room, my wife began to fail greatly in health, and lost flesh considerably; on rising in the morning complained of extreme exhaustion, and frequently vomited; the throat assumed a dark red appearance, the tongue parched, and sometimes cramp, or severe pain in the bowels, was experienced. Many times during the night I found the heart's action extremely feeble, and the hands and feet cold, and not until I had applied my ear to the region of the heart was I certain it had not ceased to beat. The effect upon myself was different; although, on waking, I felt prostrate, this passed away as soon as I left the room; yet, when I returned at night, the symptoms re-

appeared, frequent sneezing, and watery discharge from the eyes and nose, accompanied by great exhaustion. It did not occur to me until after two months of suffering, that arsenic being present in the paper might have induced some of our ailments. An examination showed that the whole surface was covered with arsenite of copper. On sleeping in the adjoining room the following night, the symptoms referred to ceased, excepting the exhaustion, which has since disappeared, and I have every reason to believe that, had we continued to use the room with the arsenical paper remaining on the walls, no human aid could have restored the balance of health."

The paper referred to in Mr. Clifton's case is now exhibited.

The following is worthy of note, as coming from the trade department rather than from the medical:—

"It is an extraordinary thing that, during my 25 years' experience in the trade, I never met with a case of arsenical poisoning amongst my own circle of acquaintance until this autumn, when a slight case came under my notice. I was at the seaside, and while there engaged apartments for an invalid friend. A few days after my friend had taken possession, a change in the weather obliged her to keep the windows shut. A marked irritation of the throat, cough, and general *malaise* was at once set up, which continued and increased day by day. I tested the paper, found it arsenical, and removed my friend into another room, the paper of which was not arsenical, when the unfavourable symptoms disappeared as if by magic."

Another case has been reported, only just in time for insertion. It is given as a striking illustration of the kind of proof to be relied upon with reference to the injurious effects of arsenical wall-papers, namely, illness produced, recovery on removal, return of symptoms on return to the arsenical paper, final recovery on the arsenical paper being taken down.

"I now forward the case of Mr. B———. The paper, since found to be arsenical, was put up in Mr. B———'s bedroom seven months ago. He was taken ill four weeks afterwards. The symptoms were remarkably complete; soreness of the eyes on waking in the morning, pain at the pit of the stomach, loss of appetite, emaciation, and general *malaise*.

"I sent Mr. B——— to Margate for change in July, and he came back, as he said, "a man again;" but, at home, the former symptoms soon returned, added to which there was intense dryness of the throat and jaws, swelling of the gums and tongue, followed by excessive irritation of the skin. The symptoms became alarming. The wall-paper was tested, and found arsenical; it has been taken down, and the patient is now rapidly recovering."

The above cases, excepting that of Mr. Brudenell Carter, are all recent, and are only a sample of the great number which have come to the knowledge of the writer within the limited circle of his own acquaintance. They, however, are sufficient to illustrate the injurious effects arising from poisonous pigments, and they alone might almost be considered as establishing a *prima facie* proof of illness arising from this cause; but, when similar cases are multiplied to an indefinite extent, there can be no doubt remaining on any unprejudiced mind. Medical men, whose attention has not been drawn to poisoning by arsenical surroundings, raise the objection that they are in the habit of giving more arsenic as a medicine than can possibly be imbibed from arsenical fabrics. True, they do put more arsenic into the stomach than can be imbibed from a wall paper, and they do it, perhaps, with beneficial effect in some cases; the legitimate conclusion to be drawn is, not that arsenical surroundings are uninjurious, but that arsenic taken into the stomach does not act in the same manner as when breathed and received through the lungs.

Another difficulty is raised, grounded on the production of arsenic from the mines, and its use in various manufactories in large quantities. It is said that arsenical fabrics, containing comparatively small quantities of arsenic, cannot possibly have the injurious effects attributed to them, for the workpeople continually exposed in these works do not suffer. That many workpeople do not suffer is, no doubt, true, but how many do suffer it is difficult to ascertain. It must be borne in mind that the majority do not palpably suffer from exposure to arsenical fabrics in domestic use, but only a minority of susceptible subjects; nevertheless, that minority is large enough to be an important proportion of the population. Susceptible subjects, attempting to gain a livelihood by exposure to arsenic, would probably soon abandon the employment, thus leaving the work to those who are able to resist it. It is marvellous what the human frame may be inured to, not only as regards arsenic, but other deleterious matter, as, for instance, sewer gas. This gas, escaping into houses, is universally admitted to be highly injurious, producing, in many cases, a well-known class of diseases; but, on the other hand, men whose occupation it is to clear out sewers, spend their working hours breathing the very atmosphere of the sewer itself, and that with perfect freedom from the deleterious effects produced by that same air escaping in small quantities into the house.

As before stated, it is said that workpeople continually exposed to arsenic, in great quantities, do not suffer. It is perfectly clear that great numbers can endure exposure to these arsenical works with impunity, but how many break down, and how many die under the ordeal, it is impossible to ascertain. No such investigation would be at all reliable unless carried out under Government authority, such as that made by Dr. Guy with regard to a manufactory of artificial leaves. (See Report of the Medical Officer of the Privy Council, 1862.)

The following is taken from Dr. Guy's report above mentioned:—

"In an establishment employing about one hundred young women, more or less suffering was almost universal amongst them; the symptoms were erythema, ulceration, excessive thirst, nausea, vomiting, fever, convulsions, &c."

In commenting on this report, and with particular reference to one case of extreme suffering described by Dr. Guy, Mr. Simon says:—

"The tortures which that poor girl must have endured will not have been in vain, if, as may be hoped, the public knowledge of them leads to the amendment of a system under which others are still day by day enduring in different proportions the progress of a similar fate."

Had Dr. Guy's investigation been carried into other works where arsenic is employed, further important information would no doubt have been elicited.

It is, of course, only under peculiar circumstances

that instances of suffering in manufactories can be reached, and, for the purposes of this paper, any attempt at investigation would have been useless, but the cases of two men, accidentally brought under the notice of the writer, may be mentioned, whose hands and various parts of the body were covered with scars of ulceration produced by printing papers with arsenical colours, some years ago, the employment of such colours now being abandoned in the factory where they work.

Another case may be given, as related by a connection of the writer's, who had the superintendence of the operation in question:—

"A quantity of emerald green, delivered in large packages, had to be redistributed. The work having to be done in haste, four extra hands, men not accustomed to the work, were put on. All had wet sponges over their mouths; nevertheless, these four extra men were made ill, one died soon after, and the other three were far more ill than the men usually employed in repacking colours."

This is a remarkable instance of the difference between men accustomed to such work and others not habituated.

The case of a young woman in a draper's shop, in one of our large provincial towns, is a good example of the serious but less virulent effect of arsenical fabrics in the course of trade. It is this young person's department to sell artificial flowers, and the mere production of them and exhibition to the customers makes her ill, so much so that she has been obliged to leave her work and have change. This report is from a medical man, a friend of the writer's.

As a further illustration of the effect which may be produced by artificial flowers, and, as a confirmation of the above statement, it may be well to give the following report from Mr. Charles Ekin, the analytical chemist of Bath, who has kindly also sent the flowers themselves. He says:—

"The history of the French flowers is this. They were procured direct from Paris by a lady residing here with her two daughters. When the flowers arrived and were being inspected, one of the daughters, who is rather an invalid, was seized with a violent shivering fit and faintness. She was taken out of the room, and, after a time, recovered. The mother and other daughters returned to the room and put away the flowers; they remembered afterwards that they too felt the same symptoms, only in a much less degree. The flowers were taken out of the box a day or two afterwards, and all three were at once affected just as before. The flowers were naturally suspected, and packed off to me at once."

The leaves are found to be highly arsenical, but not so the flowers.

The effect of arsenical wall-papers on men stripping them off or hanging them, is well-known; they are frequently obliged to desist from their work. It is stated by Mr. Heisch (analytical chemist and gas examiner to the City of London), who has paid much attention to this subject, that men suffer more from cutting the edges than in hanging the paper; this seems highly probable, for in the one case the dust would be shaken off dry, while in the other it would be rather retained by the damp of the paste.

A very important case has lately been investigated by Dr. Hardwicke, in an inquest on a young woman, who died from the poisonous effects of colours used in decoration and printing on tin plate. These colours contained carbonate of lead, acetate of lead, sulphide of tin, metallic copper, antimony, arsenite of copper, and chromic acid salts; the colours were used to a great extent as dry powder, dusted on to an adhesive surface; in this dusting operation, the person was so covered with colour as to be described as "not recognisable."

Dr. Bartlett was first engaged on the part of Government, to give information on the chemical question, and at a later stage Mr. Lakeman, the Inspector of Factories, was also called in. Dr. Bartlett analysed the colours, and both these gentlemen examined the works. They pointed out to the manufacturers that the process of dusting poisonous dry colours by hand was inevitably dangerous. It appeared there was no particular blame to be attached to the manufacturers, they merely carried on certain works in the ordinary manner customary in this country; that the process was destructive to the life and health of the persons employed, was no peculiarity of this establishment.

The point to which it is desired now to draw particular attention, is this, namely, that Dr. Bartlett and Mr. Lakeman, having pointed out the danger arising from the use of dry colours, it was stated by the manufacturers, on the last day of the inquest, that the process of using dry poisonous colours had been then abandoned. If such a change could be so readily made, why was it requisite that this poor girl's life should be sacrificed, in order to enforce attention to these well-known facts? One girl, produced as a specimen of a healthy subject employed in these works, while giving her evidence, was requested to open her mouth, the marks of lead poisoning were at once discovered.

Many cases of suffering are given in a valuable paper by Mr. Frank Draper, of the United States, published in the *Chemical News*, July 19th, 1872, and following numbers.

The foregoing statements, with regard to both the public generally and the work people, can leave little doubt on the mind of anyone, that many lives are sacrificed, and a vast amount of illness produced, by this use of arsenic. There are no doubt many employments in which life and health are freely exposed to danger under a sense of duty. The medical man and the nurse expose themselves to infectious diseases; the soldier and sailor to great dangers; workmen in mines, and in various employments, are necessarily exposed more or less to danger; but in these cases every possible precaution ought to be taken, even though the exposure is a moral duty, and the object aimed at be such as to justify the risk. Where the object in view is a great good, not to be attained without risk, the risk is justifiable; not so, however, when it is a mere paltry question, such as whether you have one shade of green paper, or another shade a trifle brighter.

The question, therefore, arises—What is gained? Why is arsenic thus used? Simply, *cui bono*? In considering this part of the question, it is requisite to distinguish carefully between fabrics for home consumption, and articles for exportation.

In considering home consumption, we have to deal with the interests of the trade supplying, and with the interests of the public using, these

articles. As to the public, the evidence on the whole tends to show that they do gain some brighter greens at lower prices, that is to say, low-class bright green poisonous papers can be produced, brighter and cheaper than non-poisonous. Arsenic is also said to give permanency, brilliancy, and body, especially to the group of aniline colours. The cost of colour in low-class papers bears an appreciable proportion to the total price of production; but in higher-class papers the difference in cost between one green pigment and another is too small to be of material importance. It should, however, be stated that some paper-stainers assert that there is no economy or advantage in using arsenical colours.

The samples now hung on the walls will satisfy those present that arsenic is not essential in order to produce a good colour; even if it be true that more brilliant tones can be obtained with than without arsenic, the difference is certainly too slight to be appreciated, except by those specially skilled in colour.

The colours in which arsenic is an essential ingredient are Scheele's, Vienna, or emerald green (practically the same thing, no matter what name it is called by), a blue (not containing copper), orpiment (containing 60 per cent. of arsenic, an expensive colour, now seldom used), and, perhaps, some few others; but it is by emerald green, used either alone or in combination, that arsenic is principally introduced; it is, however, also used without absolute necessity in a great variety of colours—red, brown, some blues, pink, low-toned greens, French greys, black, and notably in magenta; and colours are made arsenical where there is no occasion for it, merely by using up arsenical remnants which happen to be left on hand from other work. There is no doubt that, in any factory where arsenical colours are freely used for certain purposes, all the papers made will be more or less contaminated, thus accounting for the slight trace frequently found. Colour, therefore, cannot be taken as any guide to the public as regards freedom from arsenic. It is said that greater depth and sharper lines are obtained in black by the use of arsenic. The two samples now exhibited are from the same maker—the non-arsenical, if anything, somewhat the sharper and better of the two. These two, the black and olive-green papers, are a good sample of the carelessness with which such a virulent poison is introduced into our houses—the one arsenical, the other practically free; the one as good as the other, and both from the same maker. Permanency of colour is a matter of importance, and is one advantage stated to arise from the use of arsenic; but there is another side to this question, that is to say, if the public make use of fabrics coloured with poisonous pigments, it is a very questionable, benefit their being the longer exposed to them, and their superior average of durability is certainly very questionable, when the number of arsenical papers which it is now thought requisite to remove, is taken into the calculation.

It may be safely asserted that paper-stainers would suffer no injury, in the home trade, from an Act of Parliament entirely prohibiting the use of arsenic, except as regards the stocks in hand; this, however, would, in many cases, be a serious matter, very large stocks of arsenical papers being held by some makers. Were an Act suddenly passed, prohibiting the sale of arsenical papers, either the manufacturers must be compensated or they must sustain a heavy loss; the only alternative being that time must be given to sell the stocks in hand, the public being allowed to imbibe so much more poison, in order that the paper-stainers may be secured from loss. Continued additions to their stocks of arsenical papers will, however, for the future, be a matter for their own consideration, at their own estimate of the risk.

Some paper-stainers have abandoned the use of arsenical pigments for a length of time, others are now ceasing to use them, and are supplying papers guaranteed free from arsenic, stating that this change is made on account of the public feeling in the matter. It is, therefore, to be hoped that all may soon follow the same course, for it will be to the makers of non-arsenical papers that, at all events, the intelligent portion of the community will look for their decorations.

The foreign trade, however, is a more difficult question, for it is well known that a shade of colour, or a very small per-centage of extra cost, will turn the balance of the market. It seems clear that papers cannot be made of the particular shade of Scheele's green without arsenic; and though the precise colour is of no real value, the colour, together with the merest trifle in cost, may turn the balance in competition with foreign manufacturers who do use it. Therefore, as regards foreign trade, the real point will come to this—Shall the English manufacturer continue to export poisonous papers for the benefit of the trade of this country, irrespective of the effects on the foreign purchaser? This question seems to be settled in the affirmative, if we may judge by the course taken with regard to the opium trade. For the sake of £6,000,000 of Indian revenue, we continue to export that which is well known to be most deleterious to the Chinese nation. But, as regards home regulations, the opposite course is being followed to such an extent as to have become a settled principle of government. The Sale of Poisons Act and the Adulteration of Food Act establish the principle that the purchasing public shall be defended by the Government from the careless or nefarious vendor. If our Government thinks well to protect the public from water being added to their milk, is it too much to ask that our houses may be defended from arsenic? If druggists selling poisons are obliged to label them as such, is it unreasonable to require that arsenical fabrics shall be marked "arsenical?" Is there any reason against their being so marked, except that they would not sell? If there be no other reason, it proves that, in the opinion of the vendors, a large portion of the public are sufficiently alive to this question not to use these papers if aware of their nature.

Some paper-stainers state, with the most perfect confidence, that they do not use arsenic at all on their works, which is perfectly true as regards "crude arsenic;" in that condition, arsenic is not used by paper-stainers. The manufacture of colours is a distinct trade, and it is the colour-manufacturers who introduce the compounds of arsenic, passing them on to the paper-stainers in the form of arsenical pigments, which the paper-stainer may not know to be arsenical if not inquired into. Some paper-stainers, who desire to avoid arsenic

altogether, report that they find considerable difficulty in procuring pigments free from it, and find it requisite not only to contract for colours free from arsenic, but also to watch and test the colours delivered. On this question, however, the following statement from a paper-stainer is satisfactory:—"Since the question of arsenic has arisen, the attention of the colour-manufacturers, mostly abroad, has been given to the subject, and they have produced colours, guaranteed free from arsenic, so nearly equal in brilliancy that the general public could not detect the difference, except by such a close inspection as they are not likely to give. These non-arsenical colours do not add to the cost ."Another paper-stainer would rather say, "Not to any serious extent." The ceasing to use arsenical colours would not involve any expense in alteration of plant; this is a matter of some importance.

The samples now exhibited prove that there is no difficulty in producing the most satisfactory colours free from arsenic; and, as regards the home trade, the question of cost is decided by several firms having entirely abandoned the use of arsenical colours, and still holding their ground satisfactorily in the open market. In fact, it is now stated by them that, with the present feeling of the public on the subject, it is more advantageous to abandon the use of arsenical pigments, and to issue the goods guaranteed free from arsenic. The only real difficulty, therefore, as regards the home trade, is that arising from the stocks on hand. Some paper-stainers give it as their opinion that the present movement is altogether a mistake, and that injury does not arise from this cause; but, even amongst these, some have already abandoned the use of arsenical colours, others use emerald green and such pigments as cannot be produced without arsenic, avoiding them wherever, in their opinion, it is feasible.

One paper-stainer writes:—

"We may state that we have not used any emerald green for a long time, and we take every precaution to purchase such other colours as are guaranteed to us free from arsenic."

Another writes—

"I exclude all arsenical colours most carefully. 9-10ths of the colours I use are made in Germany and Belgium, and are guaranteed free from arsenic, nevertheless I also have them tested by a public analyst in this country."

A third has for some years abandoned the use of arsenical colours. Another says—

"There is difficulty in obtaining colours free. We do our best to avoid arsenic."

Another has issued the following circular:—

"The subject of arsenic in wall-paper having been so prominently brought before the public in the last few months, we have repeatedly been asked whether those manufactured by ourselves contain it. We have always been able to prove to the satisfaction of inquirers that there is no arsenic in wall-papers of our manufacture, but with a wish to completely satisfy our customers that such is the case, we invited a chemist, who had previously devoted much time to the subject of arsenic in wall-papers, to thoroughly examine our manufactures and the materials used for the same. We have now pleasure in sending you a copy of his report."

In reply to the question, "What disadvantage does a manufacturer who does not use arsenic suffer under?" the following reply has been received from a firm manufacturing on a large scale: "None whatever, but the contrary, as long as the present feeling exists. We have found it desirable to issue our price lists this year with a printed label to the effect 'that the patterns are made from colours guaranteed from the manufacturers free from arsenic.' It never has been any advantage to use arsenical colours, and as soon as others were produced we discontinued them."

The above quotations may be taken to a certain extent as expressions on the part of the trade, and from them it may be fairly gathered, that there would be no difficulty whatever in the total abandonment of arsenical pigments as regards wall papers.

A caution should, however, be given that the assurance of a manufacturer that a paper is free from arsenic cannot always be relied upon. A paper selected by the writer, marked "non-arsenical," was, after being hung, pronounced highly arsenical by Dr. Stenhouse, and this from a first-class London firm, of the highest respectability. A specimen of this paper is now exhibited.

The fact is, that many paper-stainers do not appear to be well informed as to whether their colours are arsenical or not, and it may be safely assumed that the retail dealers know very little indeed about the matter—that is, judging from the erroneous assurances so constantly given.

On the whole, it may safely be said that there is a general apprehension amongst manufacturers of wall-papers, even amongst those who do not admit the injurious effect of arsenical colours, that the public are getting too much alive to the question to allow of arsenical pigments being employed as heretofore, with profit to themselves.

It has been suggested that it may be well to turn to distemper as a security against arsenical papers; this, however, is no security, for arsenical colours are used in distemper.

In dyeing and calico printing, arsenic is used, as well as in wall-papers, but not to the same extent as regards arsenic remaining in the fabric when finished; and there cannot, it may be presumed, be any objection to the use of arsenic in certain processes where it is thoroughly washed out in the after stages, or where the trace left is so small as to be practically of no consequence. There are, however, some processes included in dyeing in which the pigment, to which the colour is due, is itself an arsenical compound, as for instance the arsenical compounds of copper producing bright green dyes, or rather pigments, the colour being due to the arsenical compound, attached superficially, rather than entering into the body of the material as a true dye. In this condition the poisonous material would of course be less firmly fixed, and would be liable to produce the symptoms described by Dr. George Owen Rees, in a letter to the *Times*, as occurring from bed curtains and green muslin coloured with Scheele's green, a square yard of which was found to contain upwards of 60 grains of the colouring matter. Chromic and ferric arseniates, which form brown and green colours, were found by Mr. Foster (Professor of Chemistry, Middlesex Hospital) to the amount of 45 grains per square yard, and 120 grains in the lining.

Arsenic is also used in dyeing in the process still called "dunging," though the material formerly used, cow-dung, has ceased to be employed. The object of this process is to remove superfluous mordants, which arise from an unavoidable excess put on in the previous stage. Instead of cow-dung, solutions of phosphate, silicate, or arseniate of soda are used; of late years, principally the latter. Here the arsenic is of use only as an intermediate agent; it forms no part or ingredient of the final colour, and it is, or should be, removed in the subsequent stages.

There is, however, another method of producing printed fabrics, in which a much larger quantity of arsenic is used. This is in fixing the aniline colours, and it consists in printing upon the cloth a thickened mixture of red liquor (alumina acetate), a solution of arsenious acid in glycerine and a solution of the aniline colour. This printing mixture may sometimes contain as much as 8 oz. or 10 oz. arsenious acid per gallon, and a piece of 25 yards might hold upon its surface, immediately after printing, as much as 2 oz. of arsenious acid. After printing, the goods are steamed, by which means an insoluble alumina arsenite is precipitated on the fibre, and this acts as a mordant, retaining the colouring matter, and fixing it on the cloth in such a way that the colours will resist soaping. This is a most objectionable process, but is not so much in favour with printers as it was some years ago; the chief advantages of the process are, that by it the colours produced are very pure and brilliant; for fastness it cannot be much recommended. Even in this case, if the goods have been well washed and soaped, the whole of the arsenic remains in combination with the alumina, and is, therefore, firmly attached to the material. But when, to avoid expense, the calico printers send their goods into the market without the subsequent soaping and washing, they may contain considerable quantities of arsenic in a loose, and therefore most injurious, condition. There are several other methods in use for fixing these aniline colours, which are free from this objectionable use of arsenic.

The two processes, that of colouring with an arsenical pigment, such as Scheele's green, and that of removal of excess of mordant, by means of arseniate of soda, may be pointed out as examples of two entirely different operations. The one in which an arsenical compound constitutes the permanent colouring, is decidedly to be condemned, for the arsenic remains an essential ingredient in the finished fabric. In the other process, the arsenic is not an essential part of the finished goods; it is, or ought to be, removed in the after stages, if so removed, no injurious effect could arise from it, and the ordinary processes of manufacture ought not to be interfered with. The question, therefore, as regards dyeing, is not quite so simple as in the matter of wall-papers; in them, if used at all, the arsenic must remain in the finished material, and such processes undoubtedly ought to be condemned; whereas in dyeing, temporary use may be made of arsenic without injury, provided it be thoroughly washed out in the following stages. A direct prohibition of the use of arsenic might therefore not be desirable as regards dyeing.

There is high authority for saying that, as Scheele's green and other arsenical pigments are not now produced on cloth by first-class calico printers, arsenic is not a necessary compound of any pigment or dye used by them, unless it be in the aniline colours; these colours, however, if properly prepared, ought not to contain arsenic in their final condition, or, if they do, it should only occur as a mere trace. English manufacturers generally extract the arsenic entirely, it being essential to the process that they do so, but foreign manufacturers adopt a different, and not so efficient a process.

Large quantities of arsenic are undoubtedly used in the production of magenta, which is the foundation of all other aniline dyes, but this arsenic ought to be abstracted in the subsequent processes, and it is so abstracted by first-class manufacturers; how far it is left in, in consequence of inferior manipulation, in some dye-works, it is difficult to say. No aniline dye tested for the purpose of this paper has been found to contain arsenic, though several samples have been examined which have produced violent irritation in the hands and feet. There seems, therefore, no reason why arsenic should not be eliminated from all dyed goods and from all cotton prints, as finally sent out for the use of the public. A sample of a stocking, which has produced very serious irritation, was received from Dr. Routh, and forwarded to Dr. Alfred Taylor. His remarks are as follows:—

"I find no arsenic in the enclosed sample. I believe the colouring is due to a mixture of coal-tar dyes, all of which are more or less irritating to the skin, more especially to an irritable skin. This is obviously a bad and unsafe dye, for the colour is not properly fixed by any mordant in the stuff. The cutaneous perspiration would suffice to draw it out, as water easily dissolves it."

The bright green arsenite of copper is a favourite colour for the cardboard boxes, now so generally used, and for labels of all kinds. Though these boxes and labels are not intended to be eaten, nevertheless, after the case of the death of a child at Peckham from sucking a piece of arsenical wall-paper, it seems undesirable to have such a poison scattered widely in our houses, no real object being gained thereby. It is reported by Dr. Wallace, of Glasgow, that on the back of a single pack of playing cards, there was found no less than 83 grains of arsenious acid. This poison, as Dr. Wallace suggests, is liable to be carried to the mouth by uneducated persons, who wet their thumbs to deal.

The impropriety of colouring confectionery and sweets with poisonous pigments needs no comment; nevertheless, it is to be feared that there is still a necessity for its prohibition, more especially as regards aniline colours, which may be arsenical, and which, if not arsenical, are, nevertheless, not desirable to be eaten. A case of a number of children being poisoned, and having a very narrow escape of their lives, is reported by Dr. Russell, of Glasgow, as having occurred in October last. Some toy sweetie watches were made with a ring of sugar, and a paper back of Scheele's green. A single piece of paper contained 0·18 grains of arsenic; the arsenical pigment was, more or less, eaten with the sugar. In fact, an hour or two amongst the cheaper sweetie shops, and the expenditure of a few shillings, would secure a large number of samples dangerous to children.

The reports of injury from arsenical paper collars are so numerous from America, from Germany, and in England, that it seems reasonable to suppose there is some truth in these statements; but, hitherto, there has been no result in the search for definite facts, vouched for by responsible parties, nor have any samples tested for the purpose of this paper proved arsenical. It is very undesirable that needless prejudice should be raised against these useful articles. At the same time, if some are arsenical and injurious, the makers ought to be known.

In the *Scientific American* of March 1st, 1879, there is a detailed report of the death of a young lady from the use of arsenical starch, but this, like the arsenical paper collars, does not appear to be confirmed by any experience in this country.

Size is used by paper-stainers, also by builders, in the preparation of walls for papering. One correspondent states that he has met with arsenic as an antiseptic in size used for these purposes. Another has found it in large quantities in size used for stiffening veils, tulle, and other articles of millinery. Fortunately, this most dangerous use of arsenic as an antiseptic in size is not general, only these two instances having been met with.

As a sample of the objectionable use of size, it may be well to draw attention to tapestry carpets, which are imitation Brussels, the wool surface of which is so superficial and so slightly secured in weaving as to require size at the back to keep it in place and to give substance or body to the fabric. The size in these carpets is often most offensive, the bad smell lasting as long as the carpet. Drains, &c., are suspected, when the mischief is really in the carpet.

The production of arsenic in this country is on a scale that will surprise most people; when it is borne in mind that two to three grains will destroy the life of a healthy man, an output of 4,809 tons, value £30,420, in one year, does indeed seem a large quantity to be dealt with. This quantity of arsenic is produced from twenty mines in Cornwall and Devonshire; it is an ingredient of copper and tin ores, and has to be separated from the metals in the process of smelting. The arsenic sublimed in the furnaces is deposited in a crystalline form in long galleries, through which the fumes are made to pass. The crude arsenic thus deposited is collected at long intervals, and passed on to the refiners. There are but six firms of refiners; from these information has been sought as to the quantity of arsenic used for colour manufacture and for dyeing, but no replies have been received. A reply to the inquiry as to how much of a virulent poison is sent out annually for use in our domestic fabrics, was, perhaps, hardly to be looked for. The withholding such information is certainly no ground for complaint, at the same time, it may be gathered that the less the public know about this matter the better for the trade.

As the arsenic must be separated from the metal, the expense of collection probably is small, and the bulk of the £30,420 per annum may be looked upon as profit.

Large quantities of arsenic are used for sheep-wash, for poisoning seed grain, in the manufacture of glass, for killing vermin, for preserving anatomical specimens, &c., as well as in pigments and dyes; but what the proportions used for the different purposes are, or how the 4,809 tons are distributed, there is no information to show.

This subject, "Our Domestic Poisons," arsenic in particular, has been considered of such importance, that the Medical Society of London has thought well to appoint a special committee to investigate the subject, with a view to bringing the matter under the consideration of the Local Government Board. A paper has already been read before that society, on the medical view of the question, by Mr. Jabez Hogg, M.R.C.S.

With a view to the investigation of the action of arsenical fabrics, experiments have been made to test the presence of arsenic in air, exposed to arsenical papers. Mr. Phillips, in the second report of the Commissioners of Inland Revenue, 1858, gives the result of his attempts. He failed to detect arsenic in gaseous combination, and goes on to say:—"It is probable that persons have been affected by inhabiting rooms papered with arsenical hangings, not because the arsenious acid has been volatilised, but from minute particles of arsenite of copper dispersed in the air;" thus upholding the dust as against the gaseous theory. Dr. Alfred Taylor also considers the arsenical dust as the principal cause of mischief, though in some cases, arseniuretted hydrogen might be evolved.

Professor Abel made experiments on the presence of arsenic in gaseous combination, but failed to discover it.

Dr. Fleck, of Dresden, did obtain arseniuretted hydrogen from a wall paper and paste, in the experiments he carried out. Professors Roscoe and Schorlemmer also obtained arseniuretted hydrogen from an arsenical wall-paper and paste, at the same time, however, they attributed injurious effects to dust as well as gas.

Professor Bamberg, of Stockholm,* observes, that "the injurious effects of arsenical pigments, as applied to the walls of apartments, have been observed by physicians in almost every civilised country." He made a very important and successful experiment himself, detecting arsenic in a gaseous form in the atmosphere of a room that had been papered for 25 or 30 years.

The following is from a manufacturer of wall-papers:—

"It appears to me that the 'dust' theory is much more tenable generally than the 'gaseous,' and much more likely to be the cause of mischief. This was especially noticeable in the case of our own men when we used arsenical colours. The printers, who work on several thicknesses of felt, called blankets, which become charged with dust, were much more affected than other workmen, having charge of different processes where the dust did not so much accumulate. Bearing this theory in mind, it is also to be remarked that the greater number of cases of arsenical wall-paper poisoning of late years may reasonably be attributed to the more extended use of machine papers, in which the colours are notably less firmly fixed by the sizing material than in the older block-printed papers."

That arsenical dust is productive of serious injury, there can be no doubt, and, in certain cases, it is clearly proved that some volatile compound is given off; but whether the injurious effects arise from dust or gas, the public look to be pro-

* The *Pharmaceutical Journal*, August 1, 1874, where a very full description of this experiment will be found.

tected from a poison, the results of which they know well by experience, though they may know nothing of its mode of action.

The information gathered whilst pursuing this subject leads to the following conclusion:—

That many persons suffer in an extreme degree from exposure to arsenical fabrics—not a few to the extent of loss of life. That, judging from the number of cases brought under notice in a private circle of friends and acquaintances during this investigation, there can be no doubt that great injury to health is produced in a vast number of persons throughout the country. There is every reason to believe that a serious amount of deterioration of the constitution is going on all around, though each individual case might not appear severe; this remark will apply more especially to children.

Great irritation is also frequently produced by articles of dress dyed with aniline colours being brought into contact with the skin. These aniline dyes produce this irritation when free from arsenic, though the injurious effect would be increased by arsenic being present also. The irritating effect of aniline dyes probably arises from unskilful management in the process of dyeing, the free dye being insufficiently washed out.

The remedy suggested would be, a law prohibiting the use of arsenic in the manufacture of all fabrics for domestic use, that is, in all those processes which leave the arsenic in the finished goods. The laws of France and Germany might be taken as a guide. The retail vendor to be liable to punishment, whether ill effects be produced or not. Such liability, however, might in many cases fall unfairly and unjustly on a retail vendor, who had taken all reasonable care to avoid arsenical articles; it is, therefore, further suggested that facilities should be given to enable the retail dealer to throw the responsibility on to the wholesale manufacturer; as, for instance, with regard to paper-hangings, the colour-maker is the real culprit, but the public have no means whatever of getting at him. If, however, the retail dealer be made responsible in the first instance, and facilities be given him, enabling him to throw the blame on the paper-stainer, and the paper-stainer again on the colour-manufacturer, each offender being only allowed to escape on his substituting another, the real culprit would be reached. Otherwise, the manufacturer of arsenical colours would practically be safe from liability. It would be the paper-stainer's duty to note his purchases of colour, so as to be able to trace them, otherwise the responsibility would rest with himself.

Finally, it is maintained that the whole subject of "Our Domestic Poisons" is a matter of such importance as to demand Government investigation.

[Specimens of arsenical and non-arsenical papers were exhibited by the author of the paper, and also specimens of non-arsenical papers by Messrs. Wm. Woollams and Co., Messrs. Jeffrey and Co., and Messrs. Coo ke.]

DISCUSSION.

The Chairman, in inviting discussion, suggested that it should take the following lines:—Definite allegations of injury to health had been made, and possibly others might be made. If they were contested, that would form one line of debate. If they were not contested and refuted, there seemed to be a *prima facie* case made for legislation; then would arise the question whether that *prima facie* case for legislation was contested, and if so, on what grounds. If it were not, it might be well to consider what the scope of the proposed legislation should be.

Mr. Jabez Hogg, M.R.C.S., having given some attention to this subject, could confirm a great deal of what had been said. A committee of the Medical Society of London, of which he was a member, was now sitting, and considering the subject on the lines pointed out by the Chairman. That committee had sent out a number of inquiries, but at present the information received was not full enough to enable them fairly to bring it before the Government, but they were getting further answers every day. They were met by certain difficulties, one being that the question was so new, even to medical men, that many of them were not prepared to give an opinion. Their patients suffered from the symptoms which had been described, but these were so identical with the symptoms of a number of other diseases, that medical men often failed to separate them. Mr. Spitta, whose name was mentioned in the paper, was, a few years ago, a disbeliever in arsenical poisoning, and only became convinced of its existence on having his attention specially directed to the subject. But the number of cases which were now authenticated were truly marvellous, and they were vouched for by men of position, whose powers of observation were undeniable. There was the case of Professor Reynolds, of Owens College, Manchester, who, having had his study freshly papered, suffered from these remarkable symptoms, which always subsided when he left the room for a few hours, and disappeared with a day's holiday in the country. This excited his attention. He discovered that the paper of his study was highly arsenical, and on removing it, he was enabled to carry on his work with comfort, whereas, before, he suffered so much that he feared he should have to abandon it altogether. There were two or three points with regard to the manufacturers themselves. No doubt many of them were earnestly desirous of avoiding any further injury to the public, and would be willing to promote any legislation which was deemed advisable; but many of those who used these arsenical pigments were not aware of the fact. For instance, in some of the aniline dyes, a dangerous contamination of arsenic was left in; and only last week he read an account in a French journal of three cases of poisoning by hydrochlorate of aniline, used by a surgeon externally. On suspecting the cause of the evil, he injected some of the aniline into the veins of a dog, and produced violent effects of poisoning. Lead again produced very serious effects, and these were sometimes observed after sleeping one night in a room newly painted. Medical men were unable to account in any satisfactory way for its fearful effects in producing paralysis. This led to the question of how the poisoning was produced; which was a most difficult question to answer. There was, however, the unmistakable clinical fact that the poisoning did take place with many individuals, some being much more susceptible than others. Whether it was the effect of some gaseous emanation, or of dust, was not of so much consequence, as the fact of its occurrence, and that medical men had hitherto seen these cases without suspecting the real cause. His own opinion, seeing that much more serious effects followed than were produced by administering arsenic internally, was that there must be something more than the mere irritation of the mucous membrane which the dust would cause. In one case, a gentleman went down to Osborne, slept in a room which had been newly papered, and the poisonous symptoms were so marked that he immediately swooned away, and remained in that condition all night. The next morning he was aroused with difficulty by the servant, and on staring round him, and seeing the bright green paper on the walls, ejacu-

lated, "Poison, poison!" much to the horror of the servant, who thought she was accused of poisoning him. He managed to put on his dressing-gown, and to leave the room, when the whole of his symptoms vanished as if by magic. Cases of that kind were so remarkable that he thought something more than the dust must be concerned, and that there must be some gaseous product which chemists could not separate. He must confess, however, that the experiments made by Mr. Phillips were not of a very satisfactory character. You could not test arsenic in the air in a laboratory under the same conditions as when a room was papered with a poisonous substance; and some eminent men were of opinion that there was arseniuretted hydrogen evolved which affected some people strongly in a very short time. The final question was whether some restriction should be placed on the sale of arsenical pigments, and he thought it would be very well if the Society of Arts, in connection with the Medical Society, were to make some representation to the Government. There was an Act to prevent the sale of poisons which said that no arsenic should be sent out in retail quantities unless coloured with charcoal, properly labelled, and in the presence of a second witness; but, while this Act applied to the sale of small quantities of poison, it said nothing about the wholesale dealing in this material. You could buy a hundredweight, and employ it how you liked; and, therefore, you could drive through the Act with the greatest possible ease. That was an anomaly which he thought the Government should take into its consideration, especially as it was evident that good colours could be prepared without arsenic.

Dr. Bartlett said he would mention some of the more important points which came before him in the case Mr. Carr had alluded to. That was an instance in which they could trace the effect of arsenical and other poisons worked out to the final issue. He was ordered by the Home Secretary to investigate the character of certain dyes, and in that case a girl died who had been at work for six weeks engaged in dusting these colours on varnished tin plates. He believed her employers were ignorant of the dangerous business they were carrying on, for they, themselves, furnished him with the materials for analysis, amongst them all those enumerated in the paper, and some others. As showing the doubts which existed in the medical mind on this subject, he might mention that the district medical officer reported that he could find nothing more than a very slight amount of inflammation of the stomach; and he was not aware whether he had preserved the contents of the stomach for analysis. As a matter of fact, the coroner's officer had done so, but as he mentioned at the time, that was exactly where he did not expect to find poison in any quantity. From his inspection of the factory, he found there was an enormous quantity of arsenical dust present in the air, the girls being positively covered with it, and if the medical man in charge of the case had had any knowledge of the way in which arsenical poisoning affected the patient, he would scarcely have given an opinion, in the first instance, that he could not account for the cause of death. There was diarrhœa, with a condition of the bowels which even the coroner observed was not in any way consistent with an ordinary attack of that malady. The girl went into the factory in moderately good health, and died in six weeks. The inquest was adjourned from time to time, and in the end, after he had proved that there were tons of poisonous pigments on the premises, and when he showed that another girl, who was brought forward as a specimen of perfect health, had symptoms of lead poisoning, the jury said there was not sufficient evidence to show by what cause the girl had come by her death. This showed that medical men were not sufficiently aware of the symptoms produced by these poisons; and if that was so in their case, how much more so in the case of the general public. Mr. Carr had done good service in bringing this subject forward, and perhaps, more so in bringing it before the public than before medical men. A large number of cases of illness from wall papers had come under his notice, and there was no doubt there was an idiosyncracy which was prone to take this poison, in the same way as others were liable to poisoning by antimony, or by ipecacuanha. Where one might pass with impunity, another would suffer to the greatest extent. He was afraid that our manufacturers, if they wished to give up the use of arsenical colours, would be at a great disadvantage. Foreigners manufactured arsenical colours, which they imported into this country, though they were not allowed to use them in their own. He stated this fact from knowledge obtained while engaged in the inquiry he had referred to. Enormous quantities of colours, which could not be used in Germany or Russia, were brought here. There was no stoppage at the Customs, nothing to prevent them being sold in wholesale quantities; so long as you did not sell pennyworths, you might sell as many cwts. as you could get customers for. If a wall paper manufacturer had not chemical knowledge, or did not submit every sample to a competent chemist, he might be disseminating these poisons with the most innocent intentions in the world; and in many instances, he believed those who had so innocently pushed forward these papers had had their business injured by persons writing to the newspapers, saying they had bought of so and so papers, guaranteed not to contain arsenic, which, on being tested, were found to be contaminated with it. It was not a question of green only, any other colour might contain it. He would not go into the question of aniline colours, but he thought all poisonous colours came under the same category. If a man ordered his room to be papered, and said he would not have an arsenical paper, and afterwards suffered from the symptoms which had been described, and had to send for a medical man, and incur expense, probably a lawyer would say that he had his remedy. Was he to apply to the man who hung the paper? and if so, would he have his remedy against the manufacturer; and then, again, could the manufacturer transfer the liability to the colour maker in Germany, who could not be got at all? The question was, should the poisonous pigments be allowed to pass the Customs. The Medical Society had taken up the question, so had the Society of Arts, and he should have much pleasure in bringing it before the Sanitary Institute, for he thought all societies which could exercise any influence ought to help in a matter of this kind.

Mr. Hale was surprised to learn that the use of arsenic was not confined to a few colours, and suggested that all wall papers should be inspected before sale.

Dr. Thudichum said Mr. Carr's endeavours had his sympathy, for the matter had occupied his attention for a long time, as it had that of other toxicologists and chemists. But on looking round the room he found his sympathies somewhat distracted. His eyes rejoiced at the beautiful bright arsenical paper, and when he looked at the abominable greys, hideous browns, and dreadful yellows made without arsenic, he could not help thinking that that would be the paper he should like to have in his room. Then came the question what that paper was. Arsenical, no doubt, but there was something else which was poisonous, viz., copper. If those papers were so poisonous as was reported, so that a man sleeping in a room with them for one night was affected as had been described, why was it all put down to the arsenic? Why was there never any symptom of poisoning by copper? He happened once to be at Marlborough-street Police-court, when a number of poor shopkeepers were prosecuted for selling green vegetables in tins, made in France; the same brands as he had eaten of himself for twenty years. There was a long array of chemical evidence, portraying the dreadful symptoms of poisoning by copper, all as

they were described in books, but he doubted if anyone had seen the symptoms in this country; and the shopkeepers were all fined for having poisoned the public with copper in the green peas. Why did not these evil results follow the use of this bright blue paper?

Dr. Bartlett said he had analysed the paper referred to, and it had no copper in it.

Dr. Thudichum said in that case it was a mystery he could not penetrate, because all Schweinfurth green or blue was arseniate of copper, and that was the pigment generally used in these papers. Arsenic had no business in a paper, except either as sulphide of arsenic, as in burnt sienna, or as arseniate of copper, as in the blue paper. In the other colours it was only present accidentally, for instance, in the so-called aniline dyes, it was a mere delusion. There ought to be none left in, and if it were, it would be removed by a good washing. If arseniate of copper were put out of the question, the rest of the arsenic would not be worth talking about. Another point was the connection of the symptoms alleged to have been produced by the dust from the arsenical papers with the alleged cause; and there, he thought, all symptonology almost came to an end. The only actual point bearing on this had been made by Dr. Bartlett, who had found arsenic in the case of the girl who died from its effects. That should be done in every case. Where it was alleged that a person suffered from arsenical poisoning, it was necessary that arsenic should be found in the excreta at the time, for, unless that were done, he did not think the poisoning by arsenic was proved. Unless you had scientific proof that arsenic had caused the mischief, the allegations would always be intangible and could be traversed by simply saying that the symptoms were so similar to natural symptoms that they could not be distinguished from them with certainty.

Mr. W. Botly thought they were much indebted to Mr. Carr, and, as a layman, he could corroborate what he had said. The son of a neighbour of his became very ill, having all the symptoms which had been described, and the doctor, at last, being unable to account for it, examined his bedroom, and finding a green paper on the walls, ordered him to leave the room, when he soon recovered, and the paper being taken down, he was quite restored to health. He was recently told by a manufacturer of arsenic in Devonshire, that he had taken an order for four tons, merely for the manufacture of dolls' eyes. It was astonishing how much was used, and in how many different ways. He should like to ask whether these papers which were so deleterious might not, by glazing or varnishing, be rendered innocuous?

Dr. A. Swaine Taylor, F.R.S., said he could express a general concurrence in what had been stated on this subject. One point which had not been noticed was, that arsenic was found in the urine of those who had suffered from sleeping in rooms with arsenical papers. Taking this together with the fact that the symptoms disappeared on changing the room, showed conclusively that the result must depend on the action of arsenic. He could quite confirm what Dr. Bartlett had stated, that all persons did not suffer alike. It was the same with lead and other poisons, some were easily affected, and others were not. When the late Louis Philippe was at Claremont, there was a case of lead poisoning through the water supply, but though the king and princes all suffered, the total number, out of a household of about 34, who were affected, was only 13 or 14. There was nothing advanced in the paper but what had been proved by experience.

Dr. Lauder Brunton, F.R.S., said he would first deal with the question whether it had been proved that the community suffered by the use of arsenical papers. As Mr. Carr had said, it was very hard for one who had not paid attention to the subject to believe that such minute quantities as could be given off were capable of producing any harm, and perhaps it was even harder for a medical man than for one of the general public, because he was in the habit of prescribing arsenic without producing any ill effects, but, on the contrary, doing great good to his patients, and this in much larger quantities than could be given off from a wall-paper. In fact, when he read a circular about two years ago on this subject, he threw it at once in the waste basket, because he did not think there could be anything in it. A few months afterwards, however, he had to change his opinion entirely. He put up a paper in his sitting-room which he had the assurance of the manufacturer that it was free from arsenic, as he thought it as well to be safe. He was constantly in the room, and shortly began to suffer from symptoms so markedly those of arsenical poisoning that he went to the man who sold him the paper, and asked if there could be any in it. He said no, every paper they sold was free from arsenic, but as his symptoms continued, he had the paper analysed, and found it was loaded with arsenic. A great number of medical men were blinded, like himself, by the fact that they gave considerable quantities of arsenic by the mouth without doing any harm. An instance of this was that of a medical man in the north of London, whose wife suffered from constant intestinal irritation; but he never suspected arsenic until the paper of the room was removed, when the symptoms at once ceased. He then suspected there was arsenic in the paper, which he believed was afterwards confirmed by an analysis. So much arsenic was used, that it was quite evident that all persons were not equally susceptible to its effects; and those who did suffer from it in this way were not injuriously affected by it when taken medicinally. He himself was an example of this. Arsenic was a favourite remedy in ague and intermittent fever, where quinine did not seem to suit, and having once taken ague in Italy, he still occasionally suffered from malarious symptoms, and had been benefited by arsenic in medicinal doses, and had, no doubt, swallowed much more than was given off from the paper, though the latter produced ill effects in less than 48 hours. This greatly increased the difficulty of collecting evidence as to the number of persons suffering from arsenical poisoning. Still, quite sufficient evidence had been obtained to show that disease was caused in numbers of cases by wall papers, and there could be little doubt that there was necessity for legisiation. In his own case, he had put up the paper at a considerable expense, he suffered a good deal, and lost a great deal of time on account of the great lassitude which followed, which seemed to be one of the most marked symptoms. When he went to the man who supplied him the paper, and told him the paper contained arsenic, he said he would communicate with the manufacturer, but all the satisfaction he got was a reply that arsenic was much more widely distributed in the mineral kingdom than medical men had any idea of. All the public were in the same condition. Some persons might not object to arsenical poisons, or might not be liable to it, but it was very hard that those who did not care to run the risk should be forced to do so unwittingly, and that when they did suffer they had no redress. For his own part, he was much disinclined to interfere with freedom of trade. If anyone wished to manufacture arsenical paper let him do so, and if any one wished to buy it, either because it was pretty or cheap, by all means let him do so; but it was very hard that those who did not want it should buy it under a guarantee, and then find they had arsenical paper after all, and have no redress. If a person bought coffee containing chicory, he could prosecute the seller, unless it were labelled as a mixture, and the same simple remedy ought to be applied in this case. He would simply pass an Act rendering it penal to sell an arsenical paper without the fact being clearly stated upon it: "this paper contains arsenic." That would not prevent the manufacture or importation of arsenical

colours, and paper-stainers could protect themselves by employing a chemist to analyse the colours before they bought them. This would meet the evil to a very great extent, if not entirely.

Dr. Bartlett said it must be printed on the front of the paper, or else it would not be visible after the paper was put up.

Mr Aumonier, as a practical paper stainer, wished to know if Mr. Carr had tested the black separately in the two samples he had referred to; if not, the arsenic would, probably, be due to the brown.

Mr. Carr said it was tested as a whole.

Mr. Aumonier could confirm Dr. Bartlett's statement, that the bright blue paper was perfectly free from copper. It was a colour of which he had never yet been able to get a specimen free from arsenic; but, within the last week, he had seen a sample very nearly as bright, quite free from arsenic, of foreign make. And here he would say a word to English colour manufacturers, to induce them to make some effort to produce bright colours free from arsenic. More than half the money he paid for colours went to France and Germany, because he could not get in England the same brilliancy of tint. Wherever there was arsenic, it was in the pigment, and not in the paper or the size, and it mainly came from emerald green. The red colours which contained arsenic were probably magenta, and tho arsenic was due simply to imperfect purification. The factory with which he was connected had discontinued the use of arsenical colours for some years, not from the belief that they were likely to cause much mischief, but partly because there was a general feeling on the part of the public against them, and they found it was quite practicable to get such tints as they wanted free from it. He thought if it were made penal to sell a colour arsenical in nature without making the fact known, it would soon put a stop to the use of them in paper-hangings; but he did not believe that in many cases paper-stainers were aware of the presence of arsenic. Unless they went to the expense of having them tested in every case, they were not likely to become acquainted with the fact, because it was impossible to tell by merely looking at the colour, or by anything which appeared on the face of it, whether it were arsenical or not. He was rather surprised that Mr. Carr had not alluded to children's toys, on which a large quantity of emerald green was frequently used, and might lead to great mischief.

Mr. Carr said the two specimens of dark colour to which he had referred came from the same pattern-book, and were supplied from the same firm, but it was possible they were not the same manufacture. With regard to the question of varnishing or glazing these arsenical papers, if the evil arose from the dust, it would appear to be a remedy, but if it arose from noxious emanations, it probably would not. He did not see how the question could satisfactorily be decided, as persons would naturally object to being experimented upon.

Dr. Mann, F.R.C.S. (who had taken the chair, Mr. Simon being obliged to leave), remarked that, if there were any deleterious action under the varnish, the varnishing would only remove it for a short time, and then the mischief would again arise. He begged leave to propose a vote of thanks to Mr. Carr for his paper. He thought the best issue would probably be that which would come from the united action of several societies. Individually he had been for a long time a sceptic in this matter; but he had overlooked two facts, which had now come out prominently; first, that the influence was only produced in certain peculiar constitutions; and also, that there seemed to be indicated some new kind of poisonous influence, some subtle action, whose nature they were unaware of. He certainly knew nothing in the action of arsenic which would account for what had been described in the case of the gentleman at Osborne; but he was satisfied that a case was made out for investigation, and he trusted that action would be taken in the matter.

The vote of thanks having been passed,

Mr. Carr said, that whatever information he had been able to give had been obtained from others, to whom he must ask leave to pass on the thanks which had been accorded to him.

MISCELLANEOUS.

TRADE WITH SIBERIA.

In view of the paper on this subject, to be read before the Society on the 4th February, by Mr. Henry Seebohm, it may be interesting to quote the following sketch of the country and its prospects, which appeared in a recent number of the *Spectator*:—

"The river Yenisei divides Siberia into two distinct parts. That to the west of it is watered by its affluents and the Obi. It contains the towns Tobolsk, Omsk, and Tomsk among others. The railway between Ekaterinburg and Perm has brought improved means of communication to within a short distance of Tobolsk, and both the Irtish and the Obi rivers, being navigable, a country as large as European Russia has, therefore, been opened up for colonisation. What has been done to the south of this region in Semipalatinsk should suffice to show how much could be accomplished in the more promising country lying northward on the banks of the Irtish. The second part to the east of the Yenisei is watered by the Lena, the Amour, and their tributaries, and is considerably larger than the first. It contains, among others, the towns Jrkutsk, Jakutsk, and Kiachta. A much larger portion of its surface is uncultivated than is the case in West Siberia, but there can be no doubt that it has the greater natural wealth of the two. Not to speak of the celebrated mines of Nerchinsk, the whole vicinity of Lake Baikal is a reservoir of coal, lead, iron, and other precious metals. The trade of Kiachta is the greatest in Siberia. That town is the key of the caravan route to Pekin. The overland trade which is, and has been for a hundred years, carried on between China and the cities of Russia in Europe, all passes from Maimachin, the Chinese frontier town, to Kiachta, and thence through Siberia to Moscow and Nijni Novgorod. It is the one trade avenue of which Russia possesses undisputed possession. The cost of transport is so great, however, that no solid benefit is derived from the monopoly, and several generations must pass away before the two thousand miles that intervene between Orenburg and Kiachta will have been bridged by means of either a railway or steam-tramway. Schemes have, however, been proposed for the connection af the three chief rivers by means of a canal, to be flooded by the waters of the great Lake Baikal. There are sanguine people who believe that this could be achieved at a cost which, comparatively to the end to be obtained, would be insignificant; but, under the most favourable circumstances, it would be a matter of the greatest difficulty, not so much to construct the three short canals necessary as to make the upper courses of these rivers navigable, whon once their volume of water had been increased from Lake Baikal. The first essential for the promotion of the welfare and material prosperity of Siberia is certainly the improvement of the means of communication, and the great rivers which find their origin in the Altai, and make their way to the icebergs of the Arctic Ocean, afford the most promising and the most economical mode of attaining the objects that are desired.

"The successful journey of Professor Nordenskiöld

serves to give more practical significance to the lessons that may be deduced from considering the growing wealth and improving prospects of Siberia. The great rivers have acquired a fresh value to the inhabitants of that country, because they enable them to send their produce to the sea—that sea which had ever before been an iron barrier both for them and for those who ventured into those waters from without. But it has now been conclusively shown that, by the exercise of a large amount of skill, that barrier can be pierced. For nearly three months in the year that barrier is no barrier, and thus sufficient time is obtained for a well-appointed steamer to make the journey to the mouth of, or even for some distance up, these rivers, take in its cargo, and return to London or any other European port. It is true that the ship must be properly equipped for the adventure, but that is a very small drawback. It is hardly necessary to insist upon the obvious fact that the most important consequence of the assured success of Professor Nordenskiöld's route would be the vast impulse it would give to the internal growth of a practically boundless country, capable of producing corn in almost inexhaustible quantities, and at a price fabulously cheap, and containing in its bosom mineral wealth of all descriptions, to which the mines of England would bear but a very insignificant proportion. The rivers mentioned are already navigated by steamers, and shippers need have no anxiety lest on reaching Yeniseik, or any of the other harbours, there should not be a sufficiently remunerative cargo to load their ships with. Not only would there be no difficulty or risk in this respect, but there is a magnificent market at those places for many English productions, and by way of an instance, it may be mentioned that salt, which sells in London for about 15s. a ton, is purchased by the Siberians in any quantities at £15 for the same weight. In the course of time, should the trade prosper, as there is good reason to believe it will, there will certainly be seaports, worthy of the name, on that solitary northern shore. The resources of Siberia will be developed, and the surplus productions, not only of Russian territory, but also of Chinese, will seek the new vent that has been provided for them."

WHEAT PRODUCTION OF CALIFORNIA.

The crop of wheat available for export from California for last year was, writes Mr. J. J. Tylor, a correspondent of the *Economist*, probably the largest known, and reached the estimated total of 20,000,000 (twenty millions) bushels, against thirteen and a half million bushels in 1878, eight and a quarter million in 1877, and seventeen million bushels in 1876, from an area about one-eighth part of the wheat producing or exporting area of the United States. The causes of the increased crop are due to increased area of land under wheat, not to increased produce per acre. The farmer in these regions owning land not exceeding ten miles distance from a railway or navigable stream can deliver his wheat at the port for 26s. per quarter, and leave a small profit in cost of production. At the present time the farmer obtains about 38s. per quarter for wheat at the place of shipment. The average production of wheat in the Pacific States from land enjoying an average of 20 inches of rainfall, and fairly regular climate, is about $2\frac{1}{2}$ quarters per acre, and these conditions represent those of the bulk of the land in these States supplying wheat for English markets. The time for sowing extends from November to March or April, during which time rain falls in quantities varying from 10 to 40 inches. In most of the wheat land the rainfall is about 16 inches from November to January, and six weeks from February to April. There is dew during May in such districts, and unbroken fine weather from May until November. Wheat ripens in June and July; then August, September, and October give uninterrupted facilities for harvesting. The machinery for reaping, winnowing, and sacking at one operation is most generally used, and always hired by the smaller farmers holding from 160 to 1,000 acres under wheat. The hiring system succeeds here whilst it has been a failure in England, because here the same machinery can do profitable work for three months, whilst in England the harvest must be got in within a week or two all over the country. It is the custom here only to remove the ears of wheat, leaving the straw standing to be burnt when convenient. Thus the reaping, winnowing, and sacking machinery is simpler and less bulky. Ploughing, except on stiff clay land, continues during the whole year. One-half of the land under wheat is sometimes left as summer fallow, but on the average three crops of grain are gathered in four years. The hot sun during the summer months kills the weeds exposed by ploughing, and cleans the land left as summer fallow.

The quality of wheat has much deteriorated in this State during the last ten years owing to the reckless manner in which the land has been cropped. Manure is now being used in the neighbourhood of the towns, and irrigation is rapidly being extended. The ground has been recklessly cropped, owing to the fact that few farmers settle permanently on the land; as a rule, settlers remain only until they have made sufficient money to go into mining or business in the towns, and their place is filled by fresh emigrants. For the future grain production of this State, a valley 350 miles long and 60 miles wide, provided with carriage by the Sacramento and San Joaquim rivers, and the Central and Southern Pacific railroads, is open to farmers. The northern half of this valley is best suited to grain, the southern half grows fruit of all kinds, including the orange, lemon, and olive. The foothills, or hilly borders skirting the Sierra Nevada and coast range on either side of this valley for 20 miles in width, are as yet but little touched by cultivation. The rainfall, as a rule, increases one inch for every hundred feet of elevation, and springs are abundant; in short, there appears to be a provision for an export of grain tenfold the present quantity.

In the southern part of the State the rain is variable in quantity, and a failure of the wheat crop is not uncommon.

THE TEMPERATURE OF THE CARBON POINTS IN THE ELECTRIC LAMP.

Early in the development of the electric light, a difference was observed in the appearance of the two carbon terminals. The positive was blunt and hollowed out in the centre; the negative was conical, pointed, and covered with the particles disintegrated from the positive. This, together with the difference of brilliancy noticed when the image of the carbons was projected on a screen, led to the same conclusion, viz., a difference of temperature between the incandescent points.

In 1844, Foucault and Fizeau wrote a paper upon this subject, in which they described the general phenomena, but gave no data from which the heat condition of the two poles could be inferred. It was not until 1862 that any careful measurements were made. In that year, the late M. Becquerel made a series of experiments on the temperature of the positive carbon. The current was supplied by a battery of 80 middle-size Bunsen cells, and the temperature was taken at the moment the light flashed forth. M. Becquerel concluded that this temperature was not constant, but that it varied between the limits of 2,070° C., and 2,100° C. Unfortunately, an assumption was made by the French physicist which has since been disproved, and hence the above figures have not been generally accepted.

It may be remarked that this determination is beset with considerable practical difficulties. The radiating

surface must be small—a mere slice of the glowing carbons, and yet it must be measured with great accuracy. M. Rosetti, an Italian physicist, who has been following up the work begun by the late Professor Henry and Father Secchi on the temperature of the various parts of the solar disc, has recently applied his method to this electric problem. He has found that the temperature of the incandescent carbons, at the moment of ignition, is not the same throughout, and is effected by a variety of circumstances, *e.g.*, the thickness of the terminals, the number of cells in the battery, the way in which they are coupled together, and the time they have been charged.

Thus, in one series of experiments, the temperature of the positive terminal was found to be 2,980° C. By using a thinner terminal, it rose to 3,065° C.; and, by changing this for a third of still smaller dimension, it reached 3,136° C.

The effect of the number of cells in the battery on the temperature is shown in the following table:—

Number of cells.	Temperature.
80	2,784° C.
70	2,536° C.
60	2,334° C.
50	2,190° C.

Foucault showed photometrically that the light produced by a battery of 80 Bunsen cells lost one-third of its intensity in less than three hours. Hence M. Rosetti was obliged to make a large number of determinations, including all the varying conditions above mentioned, before he could arrive at any very definite conclusion. In every case, however, he found the temperature of the positive pole higher than that of the negative; and, summing up his experiments, he concludes that the temperature of the positive carbon point cannot be less than 3,200° C., whilst that of the negative is at least 2,500° C.—*Engineering*.

APPLIED SCIENCE EXHIBITION, PARIS.

In consequence of the acceptance by M. Cochery of the portfolio of posts and telegraphs, M. Jules Simon was appointed President of the Superior Commission, and duly opened the Exhibition in the Palais de l'Industrie, on the 24th July, the date originally fixed. On account, however, of the building having been cleared of the pictures and statuary of the *Salon* only a fortnight previously, the exhibits were not in order, or the machines at work, before a month afterwards. The original idea of reproducing a glacier, with internal grotto and a prehistoric habitation, was abandoned; in their place were erected a pavilion for the President of the Republic, and a monumental staircase leading from the nave to the galleries. And instead of the answers to a series of questions addressed to each exhibitor as to his particular industry, which were to have constituted one of the classes, a committee of scientific inquiry, consisting of men eminent in various branches of art and science, was appointed to examine the exhibits, and issue a report independently of the awards made by the jury. An additional class was added at the last moment, embracing all that relates to infantine life; and there was some idea of holding a baby show in connection with it, though this was wisely abandoned. The Exhibition was essentially one of processes, and contained several labour-saving appliances, notably, two machines for sharpening saws, which will be noticed below. Next to machinery, the most largely represented articles were carriages, furniture, and ceramic ware; and a whole *salon* was devoted to sewing machines. Instead of noticing all the classes* in order, which would occupy too much space, the following notes of the more novel or important exhibits may be divided under a few general heads.

Mining and Metallurgy.

The Diamond Rock-Boring Companies of London were awarded a silver-gilt medal for a collection of fifty cores, or cylindrical specimens of rock, brought up by their annular drill, set with black diamonds, from various depths to 1,400 feet. They vary in diameter from 1½ to 11 inches, and also in length; but one specimen was raised entire, about 9 feet long. They were selected from as great a variety of rocks as possible, including oolite, limestone, anhydrite, gypsum, sandstone, loam, clay, and even rock-salt and potash-salt, in order to prove that actual specimens may be obtained from all strata by this system of boring. With the exception of one core, from the well at Messrs. Meux's brewery, in the Tottenham-court-road, all the specimens were obtained from Aschersleben, in Prussia, where the Continental branch of the company proved the existence of valuable potash-salt deposits, which have been turned to account as manure in reclaiming waste lands.

MM. Louis Favre et Cie., the contractors for the St. Gothard Tunnel, exhibited a whole set of plant, including an air-compressor and carriage mounted with the six varieties of rock-drill employed, which had actually been at work in the tunnel. These were only worked occasionally, on account of the great amount of power required to drive them; but a highly finished model of turbine, compressor and carriage, with two drills, was frequently set to work on a piece of granite brought from the Göschenen end of the tunnel.

The Société Française Anonyme du Nickel, Paris, which has been formed with the co-operation of M. Garnier, to import and smelt the ore discovered by him in New Caledonia, exhibited a large block of nickel ore, to which the name of "Garnierite" was given by English and American geologists, in honour of its discoverer. They also showed ingots of pure nickel, and of an alloy, half nickel and half copper, more easily dealt with by founders, besides a great variety of manufactured articles, cast, rolled, or beaten out of white nickel bronze. Their object was to prove that the same articles which are now made of brass or copper, nickel-plated, may be produced in solid nickel bronze, by the same plant and processes, and at practically the same cost, with the advantage of being the same throughout their substance, and of being easily kept bright.

Machinery.

The machinery occupied the whole of the space under the south gallery, along the centre of which a line of shafting, in two lengths, had been erected by M. Rikkers, of St. Denis, who also supplied the motive power. The boilers were all of the vertical type, but their distinguishing feature is that the water tubes, which hang down into the firebox, follow mainly the shape of the letter U, one branch being of larger diameter than the other. By arranging the tubes radially with the smaller branches in the centre, more tubes can be got into a smaller space; and as the smaller branches have a larger heating surface in proportion than the larger, and are, besides, exposed to the most intense heat of the furnace, the circulation is very active. The engine that drove the larger portion of shafting is of novel design, and gave off 98 per cent. of the theoretical effect. The double piston-rods of two horizontal cylinders, placed face to face, are connected by a cross head, and work direct on to the crank-pin without any connecting-rod.

M. Goubet, St. Denis, showed a method of transmitting power by a shaft out of the straight line, which he effects by introducing a universal joint into the shaft. A practical application was shown in a model of steering gear for vessels, the propeller being placed in the middle of the rudder, which can be made to form an angle of 90 degrees with the main portion of the shaft without interrupting its revolution.

* The classification was given in No. 1,371, vol. xxvii., at p. 314.

M. Emanuel Farcot, Paris, showed in action a new dynamometer of his design and construction, by which the power absorbed by any machine may be ascertained at once by means of weights on a scale beam. He also showed a new lamellar injector for feeding steam boilers, and a centrifugal fan, as to which he has a new theory.

The Société de Construction de Passy had erected a whole set of milling machinery on the Hungarian system, by which the corn is crushed between steel rolls instead of being ground by stones in the usual way. The advantages of this system are that the flour is not heated in passing momentarily through the rolls as it is while being ground between stones, so that the flour runs no danger of being converted into starch; and the flour is whiter and of a better quality, owing to the absence of fine particles of bran, which, in stone-grinding, become mixed with the flour, and cannot be removed by any known process.

Appliances for raising water were very numerous; and two of them are quite new and original. M. Lagoge, of Paris, showed his "*pulsateur*," in which steam is utilised in a two-fold manner; it first forces the water upwards through the delivery valve by pressing on an india-rubber diaphragm, and then, on being condensed, causes a vacuum, to fill which, some more water rushes up from below. M. Dudon-Mahon showed in action his "*balancier hydraulique*," by which, with a fall of 4 ft., water may be raised to any height. Two chambers are mounted on the ends of a beam, like the bell-crank of mining-pumps, to which the pump rods are connected; and these, being alternately filled and emptied while the valves open and close automatically, cause the beam to oscillate, and thus work the pumps. MM. Bichon et Cie., Paris, showed the new Keiser pump, specially intended for emptying the cesspools of Paris and other large towns in France. It is provided with new joints by which it is quickly and easily connected to the hose pipes, and also with india-rubber lip valves, something like those of Perreaux, for allowing corks, broken bottles, and other extraneous substances to pass freely. It is mounted on a pair of wheels, and worked by a lever. This firm also showed, in action, their new saw-sharpening machine. A circular file, in the shape of a bevel-edged disc, makes a few evolutions to effect the sharpening of a tooth, and then, owing to an ingenious arrangement of the gear, stops while a wiper on the fly-wheel acts on a pawl, which causes the saw to move onwards the space of a tooth. Straight saws travel along in a kind of slide-rest, circular saws revolve on a horizontal spindle, and band saws pass round a pair of flanged horizontal pulleys. M. Martinier, of Cognin, Isère, also sent a saw-sharpening machine; but, in this instance, a triangular file, mounted on an articulated parallelogram, is moved forward by a cam, which also raises it from the saw during the return stroke.

MM. Th. Dupuy et Fils, Paris and London, received a gold medal for their compressing machine for making bricks, briquettes from coal dust, and other conglomerates. Its distinguishing feature is that the degree of compression can be altered, in the same machine, to suit various substances to be conglomerated. This is the machine that is used by the Eastern Railway Company of France for making briquettes from the waste fuel of locomotives.* M. Fleury showed in action a continuous brick-moulding machine, in which the moulds, arranged in a circle, constantly revolve in a horizontal plane. The clay is fed into them just in front of a heavy conical roller; and the bottoms of the moulds rise, so as to throw out the bricks when moulded, and then fall again ready to receive more clay. M. Jannot, Paris, sent a combined grinder, mixer, and elevator, in which springs allow the rolls to rise when encountering too large an obstacle, and revolving scoops raise the crushed material and allow it to fall on to a conical riddle in the centre.

* See "Utilisation of the Waste Fuel of Locomotives," No. 1,394, p 838.

MM. Gary Frères, Paris, showed a manual stone-sawing machine, which consists of an ordinary stone-saw, mounted in a frame, and made to move backwards and forwards by a crank and connecting-rod from a fly-wheel and handle. A depth of 6 ft. in soft stone, and 6 in. in hard, is cut in an hour; and one man with the machine can do as much as four without it, while the surface of the sawn stone is more regular. M. Thiersot, of Paris, sent an improved fret-saw, with an elastic arm composed of plate springs, with the addition of spiral springs for still greater elasticity. M. Romary, also of Paris, showed an originally-designed band-saw, worked by a jointed, triangular pedal, with gearing to increase the speed. The canting table is held by two grooved semi-circular plates, which permit of the table being cut with an inverted V, to allow the passage of the saw, and yet leave no space at each side of it on the upper surface of the table.

Machine-made lace is woven in a piece composed of several breadths, which are afterwards separated by hand with a pair of scissors. This tedious operation is rendered unnecessary by the treadle scalloping-machine of MM. Lebœuf et Deschamps, which separates the breadths, of whatever pattern the edge may be.

In the Machinery Hall were shown specimens and applications of a remarkable substance prepared by Señor Unciti, of Barcelona, and said to be grease deprived of one of its constituents. It is claimed to act as a good lubricant, to remove boiler incrustations, and prevent further incrustation, with all waters; to prevent boiler-plates from burning and hasten the generation of steam; and, finally, to prevent the oxidation of iron and steel articles, which have remained coated with it for 24 hours. Practical demonstrations of some of these qualities were given in the Exhibition and its annexes; and further experiments are now being made in England.

Building.

Some specimens of pillars, vases, balustrades, and flooring, with a model of spiral staircase, all in artificial stone, were sent by M. Dumesnil, Paris, a member of the Jury for Applied Geology. They have the merit of possessing a smooth exterior not effected by weather, and being of a cheerful white colour all through the substance. A system of fire-proof floors was sent from the Grande Tuillerie de Bourgogne, consisting of hollow red tiles, forming segments of an arch, supported on rolled joists. M. Perrière, mason, Paris, showed a somewhat similar arrangement, but in this case moulded slabs of plaster, with longitudinal cylindrical holes, were supported by the iron joists.

M. Quincel, a zinc-worker, Orsay, Seine et Oise, sent a model, illustrating his system of covering roofs with sheet zinc, without nails, the heads of which are broken off by the expansion and contraction of the metal. The method is simple and practical, permitting the sheets to be easily removed for repairs to the roof. The Société des Forges de Montataire showed their "metallic slates" of galvanised iron for the same purpose.

An ingenious arrangement for supporting the centering of arches was shown by M. Camusat. It consists of a cylindrical box of sheet iron, provided with several holes near the bottom, stopped with plugs. The uprights are supported by sand, rammed into the box; and when it is required to strike the centering, all that is necessary is to remove the plugs, when the sand runs out, and allows the uprights to drop.

Lighting and Heating.

During the dark afternoons, before the close of the Exhibition, the Machinery Department was illuminated by the electric light apparatus of Messrs. Siemens Bros., and MM. Lontin et Cie.; and the Oriental Court was lighted up by air gas, made by carburetting

atmospheric air with petroleum spirit at 680 degrees, in the apparatus, including a heater, of M. Albert Lascols, Paris.

MM. Jousseaume Frères, Ivry-sur-Seine, showed specimens of gas retorts, coated within and without with a special cement, which prevents loss of gas through the pores of the fire-clay, and also the adhesion of particles of the graphite which is usually deposited, to the diminution of the capacity of the retort. M. T. Schreiber, Saint-Quentin, erected some small gasworks in the annexe, with special retorts for distilling gas from boghead, wood, cork waste, fatty matters, heavy oils, and the residue of petroleum. He made the gas on the spot with various substances, and burnt it in one of the new lamps brought out by the Compagnie Parisienne du Gas. This lamp has six ordinary burners, the flames of which impinge upon each other and form a *corona*, causing such intense heat as to greatly improve the combustion, which is further aided by draughts of air directed, by an internal and external glass, just on to the flame. A small protected jet is constantly burning for lighting the rest without opening the lamp; and there is also a single burner above the rest for use when the full light is not required. The Rue du 4 Septembre, and other streets in Paris, have been provided with these lamps (each of which gives a light of 140 candles), by way of competition with the electric light.

Heating stoves in great variety were exhibited, some of them in action during the cold days towards the close of the Exhibition. In one of them, unprovided with a chimney, it is pretended that the carbonic acid is condensed in a pan of water. The "moveable stove," Place de l'Opéra, Paris, runs upon three wheels, and has a short up-turned pipe, so that it can be wheeled about, ready lighted, from room to room, the pipe being placed under the chimney without any fixing. It is said to keep alight for twelve hours without attention, and to be capable of regulation so as to burn from 15 to 40 litres of coke a day. The "*Calorifère Phénix*" of M. Peyre Gough, Paris, is a slow combustion stove, with an inverted hollow cone, closed at the top with a cover set in sand, to make a tight joint, and surrounded by an outer case. A fire is lighted at the bottom of the conical receptacle, which is then filled with small coke; and combustion goes on at the bottom only, until all the coke is consumed. M. Bertrams, of Paris, showed several specimens of his sheet iron bends for stove pipes, made by puckering up the insides of the bend, while the outside is quite smooth.

M. Wéry, Paris, showed in action his smoke-consuming chimney for furnaces and steam-boilers. He admits air at suitable points in the chimney, for causing the combustion of the colourless gases and a large portion of the smoke, whereby he claims to effect a saving in fuel from 25 to 35 per cent, according to its nature, and to obtain an equal draught with one-fourth the height of chimney.

A new *chaufferette*, or foot-warmer, was shown by MM. J. Lefranc et Cie, Paris, which has been adopted by the leading cab companies of that city, and also, as far as their existing arrangements would permit, by some of the French railway companies. It consists of a sheet-iron box of the usual shape, covered or not with carpet, and provided with a sliding drawer, over which the air can pass freely through holes in the ends. *Briquettes* of pure and highly compressed carbon are made from a mixture of coke, peat, and spent tan, to which some chemical substances are added. When required for use, one of these is raised to a red heat in any fire, then exposed to the air for a second or two, that it may part with the sulphurous fumes it has taken up from the coal, and then inserted in the drawer, where it will continue burning, for 14 hours in a carriage, or 16 hours in an apartment, until the whole is consumed, giving out no objectionable odour.

GENERAL NOTES.

Vaccination.—Mr. Ernest Hart will lecture before the National Health Society, on "Small-pox and Vaccination," in answer to the question, "Is Vaccination an Antidote to Small-pox?" on Tuesday, 27th inst., at the rooms of the Society of Arts. Admission will be by card, and the hour fixed is 3 o'clock.

School of Music at Watford.—The Committee of the Watford Public Library have appointed a sub-committee to form a school of music, on the lines indicated in the report of the Musical Committee of the Society of Arts. The Watford Library, which is a rate-supported institution, already has a school of art and science classes.

Sorghum Cultivation in America.—The cultivation of sorghum as a sugar-yielding plant is receiving increased attention in America, especially in the trans-Mississippi States and territories, where the result of the year's culture is reported as being very satisfactory. On the Atlantic and Gulf coasts there is on the whole a considerable increase. In Virginia the produce of 1878 is said to have been 41 per cent. greater than that of 1877. A variety called the Redhead is growing in favour with the farmers of South Carolina. In the west the Minnesota Amber-cane has produced the most satisfactory results. In Stearns County, Minnesota, this variety is reported as yielding as high as 300 gallons of syrup per acre. Delaware County, Iowa, manufactured 100,000 gallons of sorghum syrup during the year, and found a steady home demand for the whole.—*Gardener's Chronicle.*

A New Substitute for Hops.—The destruction of vines by the *Phylloxera* has turned the attention of French producers to the manufacture of beer, but the expense of hops has proved a serious obstacle. A substitute has, however, been found in the shrubby trefoil or three leaved Ptelea (*P. trifoliata*). At an agricultural show held at Chalon-sur-Marne, on the 20th September, M. Ponsard, president of the committee, presented a new beer, which he termed Ptelea beer. This beverage was found to be identical in flavour with that of the best beer made with hops. It was of a pure, handsome amber colour, remarkably limpid, and equal in flavour to the best Strasburg beer. This Samarian elm, as the French term it, is a hardy North American shrub, perfectly acclimatised in France in all kinds of soils. The winged fruit or seed resembles that of the elm, and gives out an aromatic odour when rubbed. Lindley, in his "Vegetable Kingdom," speaks of the fruit as having a strong, bitter aromatic taste, and as having been used with some success as a substitute for hops.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

JANUARY 28.—"The Future of Epping Forest." By WILLIAM PAUL, F.L.S. JOHN T. BEDFORD, Chairman of the Epping Forest Committee, will preside.

FEBRUARY 4.—"Trade and Commerce with Siberia, *viâ* the Kara Sea." By HENRY SEEBOHM.

FEBRUARY 11.—"A New Metallic Compound and its Application to Industrial and Artistic Purposes." By GRANVILLE COLE, Ph.D.

FEBRUARY 18.—"The Euphrates Valley Railway." By W. P. ANDREW.

FEBRUARY 25.—"The Art of the Silversmith." By W. HERBERT SINGER.

MARCH 3.—"The History of Musical Pitch." By ALEXANDER J. ELLIS, F.R.S.

MARCH 10.—"Recent Advances in the Production of Lambeth Art Pottery." By JOHN SPARKES.

MARCH 17.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

APRIL 7.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday Evenings, at eight o'clock:—

FEBRUARY 12.—"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.

MARCH 11.—"The Noxious Gases Bill." By E. K. MUSPRATT, F.C.S.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

JANUARY 30.—"Herat." By Colonel G. B. Malleson, C.S.I. ADMIRAL SELWYN will preside.

FEBRUARY 20.—

MARCH 5.—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"The Present Condition and Prospects of Agriculture in South India." By W. ROBERTSON, M.P.C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 3.—"Social and Commercial Prospects in the Transvaal." By the Rev. G. BLENCOWE (late of the Transvaal and Natal). W. C. SERGEAUNT, C.B., will preside.

FEBRUARY 24.—"Views of Colonization." By WILLIAM FORSTER, of New South Wales. Sir CHARLES NICHOLSON, Bart., will preside.

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES. Sir RUTHERFORD ALCOCK, K.C.B., will preside.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

CANTOR LECTURES.

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S., will be delivered on Mondays, February 2, 9, 17, 23; March 1, 8.

LECTURE I.—FEBRUARY 2.

Sources of India-rubber. Chemical and physical properties. Behaviour with chemical reagents. Action of various solvents. Effects of heat, cold, aud light.

LECTURE II.—FEBRUARY 9.

Mechanical and chemical purification. Working of unvulcanised caoutchouc. Formation of blocks, sheets, and threads. Elastic webbing. Other uses of unvulcanised India-rubber.

LECTURE III.—FEBRUARY 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 26TH..Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. Thomas Porter, "Architectural Competitions."
Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Messrs. G. King and G. F. Hardy, "Notes on the Practical Application of Mr. Makeham's Formula to the Graduation of Mortality Tables."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. B. Tylor, "The History of Inventions."

TUESDAY, JAN. 27TH...National Health Society (at the HOUSE OF THE SOCIETY OF ARTS), 3 p.m. Mr. Ernest Hart, "Small-pox and Vaccination; an Answer to Anti-Vaccinators."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. A. Schäfer, "Physiology of Muscle." (Lecture III.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion upon "Fixed and Movable Weirs."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. Annual Meeting.

WEDNESDAY, JAN. 28TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. W. Paul, "The Future of Epping Forest."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Dr. C. M. Ingleby, "The Spelling Reform Deadlock."
Telegraphic Engineers, 4, Broad Sanctuary, S.W., 8 p.m. Inaugural Address by the President, Mr. W. H. Preece.

THURSDAY, JAN. 29TH...Spelling Reform Association (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Public Meeting.
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. Henry B. Wheatley, "Two Centuries of Shakespearean Acting."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. J. W. Bradley, "Book Decoration."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture I.)
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

FRIDAY, JAN. 30TH ... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Col. G. B. Malleson, "Herat."
Royal Institution, Albermarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Mr. John Marshall, "Proportions of the Human Figure."
Institute of Bankers (in the Theatre of the London Institution, Finsbury-circus, E.C.), 6 p.m. Mr. J. Biddulph Martin, "Bank Notes."

SATURDAY, JAN. 31ST...Royal Institution, Albemarle-street, W., 3 p.m. Prof. T. Rupert Jones, "Coal." (Lecture III.)

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FRIDAY, JANUARY 30, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

BRITISH MUSEUM CATALOGUE OF PRINTED BOOKS.

The announcement made in the Society's *Journal*, of the 16th January, that the first instalment of the printed catalogue would shortly be issued, is now supplemented by details given in the *Athenæum*, of the 24th, as follows :—

"A beginning has already been made in printing the Catalogue of the Library of the British Museum. For the convenience of subscribers, the catalogue of the acquisitions of each year will be arranged in four classes, viz., Class 1, Modern English Works; Class 2, Modern Foreign Works; Class 3, Old English Works; and Class 4, Old Foreign Works. In addition to these classes there will be printed all the titles of works received by the Museum before the first inst., which have not been transcribed for the MS. Catalogue, as well as all titles of Oriental works. Messrs. Clowes and Sons are the printers of the new Catalogue."

PROCEEDINGS OF THE SOCIETY.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday, January 22nd, 1880; Capt. DOUGLAS GALTON, C.B., F.R.S., Vice-President of the Society, in the chair.

The paper read was—

THE TEACHING OF TECHNICAL PHYSICS.

By Professor John Perry, B.E.

In the struggle for existence of men and nations, the most important factor at all times has been a knowledge of social and natural science, and to acquire and add to this knowledge, and apply it in all his actions, is the study of man from the cradle to the grave. Every man knows, perhaps unconsciously, what are the things which he may not do with impunity against the laws of nature, and what are the phenomena of nature on whose recurrence he may depend; he knows that a better knowledge of physics will give him more help from nature's resources. Most men tumble up through boyhood without special teaching in physics, but in numberless ways they obtain a practical knowledge; that is, they are so environed by the forces of nature, that in every action they are learning from observation and experiment. Every man is constantly being influenced by the results of his own experience, and on performing any new action, he unconsciously uses a physical theory of his own. The object of teaching physical science is to give all men the same language in which to express their experience, so that all may employ the best methods of simplifying the phenemena which they have to study, and give their results to other people.

The principles of physical science are, like any other language, most easily learnt in youth. I have known children to gain a greater colloquial knowledge of a foreign language in six months than their parents gained in as many years. What a wondrous meaning and history is contained in almost every word of every language, yet a child learns to use the word unconsciously. No doubt such words as these, when they were first invented, were studied over and lectured upon, just as is the parallelogram of forces now, and we may depend upon it that children of the future will take in the idea of the truth of the parallelogram of forces as easily as they now accept the simplest of Euclid's axioms. When Egyptian and Chaldean philosophers spent years in difficult calculations, which would now be thought easy by young children, doubtless they had the same notions of the depth of their knowledge that Sir Wm. Thomson might have now of his. How is it, then, that Thomson has gained his immense knowledge in the time taken by a Chaldean philosopher to acquire a simple knowledge of arithmetic? The reason is plain. Thomson, when a child, was taught in a few years more than all that was known three thousand years ago of the properties of numbers. When it is found essential to a boy's future that machinery should be given to his brain, it is given to him; he is taught to use it, and his bright memory makes the use of it a second nature to him; but it is not till after life that he makes a close investigation of what there actually is in his brain, which has enabled him to do so much. It is taken in because a child has much faith. In after years, he will accept nothing without careful consideration. The machinery given to the brains of children is getting more and more complicated as time goes on; but there is really no reason why it should not be taken in as easily, and used as readily, as were the axioms of childish education in ancient Chaldea. A watch is a complicated piece of mechanism, which it has taken the thought of all the ages to elaborate, but the smallest boy can make it useful to himself. In a recent number of *Macmillan's Magazine*, there is a paper by the late Professor Clifford, on "Boundaries." It directs attention to some of the simplest mathematical ideas. I felt, when reading it, that nobody could take a greater interest in it than a mathematician who had long used those ideas. The notion of a boundary had long been simple to him, and useful, like his watch to a boy; but one day he looks into its mechanism, and, without its becoming less useful he finds that it opens up for him a world o

thought. The simplest-looking geometrical idea, the simplest statement of any general law in nature, is a result of the experience of many generations of animals and men. The student who cavils at Euclid's axioms, who refuses to employ the idea of limits and of infinities, will probably never advance very far in mathematics; and this is one of the reasons why ladies find so much difficulty in their studies; they begin after their reasoning faculties are developed. It is interesting, from this point of view, to listen to remarks made by lady students of mathematics about their teachers. They assert that it is because mathematics has so long been the peculiar property of men, and, therefore, of coarser intelligences, that doctrines such as that of limits and infinities should be accepted without question by students. They cannot understand that they are really beginning in the middle of the subject, that to begin at the real beginning would be utterly impossible, and, in fact, that mathematics is merely an inductive science based on experience.

It follows from what has just been said, that a system of education which suits one generation may be very unfit for the next; what suits boys in schools may be unfit for grown-up women and men; and, in teaching natural philosophy, which includes mathematics, we may begin on any data that are believed by our students, if we know them to be true. It is to be remembered, however, that the great distinction between children and adults lies in this, that children are ready to believe anything, although we may have some difficulty in making them understand; whereas, adults can understand easily, although they may not believe readily.

It is easy to show that, when a system of education becomes fossilised, and when it is the interest of any body of men to oppose changes in it, it becomes degraded. Take, for instance, the teaching of Euclid in schools. It is quite possible to begin more in the middle of the subject of geometry, teaching students to test by actual experiment the truth of many of Euclid's propositions, giving them data which they know to be experimentally true, and which we know to be generally true; to give them a real interest in what they work at by commencing early the study of physics, so that their observational and reasoning faculties may be more rapidly developed than they possibly can be when we begin with abstract truths, and a series of enigmas, like extracts from the Shorter Catechism of the Presbyterian Church. Our Tom Tullivers sit brooding by the hour over a proposition in Euclid, hardening their hearts, and dulling their understandings, and we call it mental training. Why not tell the boy that the forty-seventh proposition is always true, and let him test the truth with squares of paper and with numbers. Following Euclid, he will not understand that he has proved a proposition until years after he believes in its truth. But, if we begin to teach him physics at once, he will see that not only is he getting mental training, but every result which he gets out has its useful applications. I know that many workmen who begin Euclid with energy, give it up after a year or two in disgust, because at the end they have only arrived at results which they knew experimentally long ago. The idea that a study ought to appear to be useful to a student, is ridiculed overmuch, I think. Like all wide-spread notions, it is founded on common sense, and I believe that any teacher who neglects to consider the instinctive preference of his pupils to reason about things rather than about ideas, is a man who persistently refuses the powerful aid of nature. I may also remark that, besides the waste of time, there is another consequence of training in Euclid which ought to be much deplored, namely, that men think too much of logic and too little of the matters to which the logic is applied. Euclid's axioms are so true that the consequences derived from them do not require to be tested, and hence men trained in this school are apt to believe too well in the logical consequences of any seemingly general fact, forgetting that very few general statements are absolutely true and that all logical consequences have to be tested experience before we can say that they are true.

I would suggest that no child of less than fourteen years be compelled to take up Euclid, and, indeed, that nobody take up this study until he has been well grounded in physics, the study of which can begin at any age, and, indeed, does now begin in infant schools under the kinder-garten system; that we urge forward the introduction of a decimal system of weights and measures, and make more use of what is known as the scientific method of teaching arithmetic; that practical, plane, and solid geometry, made simpler than it is at present, be taught as an experimental subject, like mechanics and heat; and that algebra be taken up as it enters into physics, and just so far as it is necessary for obtaining a quantitative knowledge of the phenomena of nature, but that it and a little trigonometry should precede Euclid. I have no doubt that if this system is followed it will be found easy to give to boys, before they leave the primary schools, not only a good knowledge of natural science, but also a power of observation, a thirst for information, and a method of reasoning which will serve them much better in this nineteenth century than what is to be obtained in any other way.

It will be seen that, in speaking of physics, I have been dealing altogether with quantitative experimental physics. The study of physics cannot exercise the reasoning faculties unless it is quantitative. It may exercise the wonder of a child, it may please his senses, to see certain well-known experiments, say in electricity, where, with glass-legged stools, and Leyden jars, and electric machines, the teacher may show off numberless tricks to his audience; and, possibly, for young children, there may be great instruction in such exhibitions, but they ought not to continue too long, nor ought they to be given, except as a preface to quantitative experiments.

In pointing out that, as time goes on, we must begin from more and more comprehensive data, in fact, that pupils must commence their studies farther and farther from the real beginning of the subject, I point to a fact of which every teacher of physics gets good evidence, even in the history of twenty years. Teachers of mathematics have not this evidence; but the teaching of natural science is obeying natural laws as yet, not being fettered by crystallised rules and vested interests. Instead of teaching pupils a great mass of disconnected facts, and giving them lectures on virtual

velocities, and the like, as was common ten years ago, we begin with a great generalisation, the law of conservation of energy. And yet, after this generalisation was known to men of science, how long it was before teachers ventured to prune away excrescences from the text-books; how long it was before they ventured to say, "It is not necessary to teach as we ourselves were taught; we can do better; we can give in a few words, and illustrate by a few experiments, a general law which it required years for us to understand." Changes occur slowly; books are still written as they used to be written years ago; and it takes long for our older professors and teachers to recognise the need for modern text-books like Thomson and Tait's "Elements of Natural Philosophy," or the valuable little book of Dr. Lodge. Any person who takes up Everett's "Natural Philosophy," or Fleeming Jenkin's "Electricity," or any of the more modern text-books, will see that in physics we are really beginning at more and more advanced points of the study of physics. Instead of finding in these books a mere record of old experiments, described just as they were originally performed and described by their discoverers, we find that fewer experiments are given, and what are given lead the reader naturally to the generalised principles under which all such phenomena may be grouped. Of course the student knows that to test completely any such principle would take a lifetime, but he has faith in what other men have done, and it is sufficient to give him just so much experimental illustration of a principle as he can grasp and can use. Nothing has so much conduced to this generalisation as actual measurements of phenomena and the use of mathematics. Hundreds of seemingly disconnected phenomena are shown to be included under one principle, when we study them quantitatively.

In teaching physics at a public school in 1870-3, I was greatly helped by possessing a workshop, where most of the boys were able to make apparatus with which they could, themselves, repeat all the experiments shown to them in lectures; and even with the limited supply of apparatus in my possession, I was enabled to let every boy manipulate for himself the proofs of most well-known physical principles. I consider that nothing is more important in a school than this, the actual handling and constructing of simple apparatus by the boys themselves. Beyond this it is almost impossible to go in a school laboratory, except with one or two pupils who may really prefer helping in weary observations to cricket or foot-ball. I remember that two such pupils had the patience to take up of themselves the repetition of most of the experiments recorded in a very long scientific paper by an eminent physicist; but, indeed, the duties of both master and boys at a public school, are too heavy to allow much of this kind of work, or of original work, to go on. I wish I had time at my command to apply the theory, that methods of education which suit one generation ought to be altered for the next, not merely to that minor part of the study at any public school, mathematics and natural philosophy, but to all the studies there, and to comment upon the questionable wisdom shown in the most advanced schools, of shunting to these subjects such boys as do not show ability in ancient classics.

If the changes in teaching mathematics which are suggested above take place in primary schools, I see no reason why the principles of physics should not be intimately known to every child who has passed the age of twelve years; that is, if the lectures given to the children be illustrated by simple apparatus, such as the Science and Art Department helps to supply, if the teacher is himself acquainted with quantitative experimental physics, and if the children are encouraged to make simple apparatus for themselves, and to handle the school apparatus. An examination of the work carried on in the Model National Schools in Ireland, will show that in many cases children of eleven and twelve years possess a fair knowledge of physics and chemistry, and when they do not possess this knowledge, it will be found that too much attention has been paid to Euclid and grammar, and perhaps practical geometry has not been studied at all.

Technical physics is the application of the principles of natural philosophy to particular trades. Thus, for instance, a man who makes steam-engines ought to be acquainted with the laws of heat, the behaviour of steam and water under different conditions, the properties of iron, brass, oil, &c., with stress and strain phenomena, and the strength of structures. His knowledge of the principles of natural philosophy ought to be such that he can imagine the molecular action going on when two surfaces rub together, when the volume of a gas or vapour is suddenly changed, when a piece of metal communicates forces. It is the resultant of all his knowledge, and notions, and instincts which he brings to bear upon a piece of metal that he is chipping or filing, and the greater is his knowledge, the more exact are his notions, and the truer to natural laws are his instincts, the better an engineer must he be. When a boy enters a workshop, however good may be his knowledge of the principles of natural science, he cannot readily understand all the operations going on about him. He must be taught the application of his knowledge to a particular trade. This application of his knowledge is really a higher study of physics. Technical physics is simply advanced physics, so advanced that the boy becomes a specialist. All his future life is that of an experimental physicist, who is attaining a greater and greater knowledge of a particular part of his subject. A workman enters more into direct converse with the laws of nature, and especially with what is called "molecular physics," than any other man. To him, too, nature speaks in a more complex way than to the laboratory student. The laboratory student may vary his temperatures, his pressures, his stresses at will, and may experiment on a phenomenon, making its conditions less and less complicated; whereas the workman has to take phenomena as they occur in his trade, using all the knowledge which different laboratory students may give him, so as to enable him to understand the complex phenomena really occurring before him.

Buckle brings out strongly the reasons why the aborigines of a country of great rivers, and earthquakes, and volcanoes, and tornadoes, are often so low in the scale of humanity. The actions of nature are so complex and mighty, that the human spirit is crushed. But when to such a country comes a race who have got to understand nature's

laws, who can bridge the largest rivers, and build houses to withstand earthquakes and tornadoes, the opportunities given to such a race of fighting with and better understanding nature, may raise it to the highest civilisation. Our workmen have long been stolid enough, and have long enough given up ideas of understanding the complex phenomena with which they work, but give them a knowledge of physical science, such as we know will enable them to understand their work, and one year's advance in their knowledge of nature will be worth ten years of our present laboratory progress. English workmen are acknowledged to have greater manual dexterity than workmen of any other country, and I do not think that we can improve them in this respect. If you want a really perfect piece of work of any kind, where patience and honest painstaking labour are of chief importance, you must get it from an English workshop. What, then, is the nature of the improvement which we want to see effected in English trade? The fact is, our workmen are machines, and we know that in time other machines will be constructed to do the same work at less than half the cost. There is none of that perfection of workmanship on which we vaunt ourselves which may not be done as well and cheaper by regular machinery. We see all this in time to make a reformation, and we hope to use the brains as well as the hands of our English workmen, as they are doing in the United States. Till now we have made little use of our workmen's brain power. It is a fact that every year in England we build structures, and make machinery, using twice as much metal as is really required, following rule-of-thumb and precedent, and, in the fear of weakness, without having the power to calculate, we make things clumsy; we give perfection of workmanship where none is required; use the hands of thinking men in repeated operations of exactly the same kind, which much less costly machinery might be applied to; and neglect the use of valuable brain power so much that a new idea cannot be entertained, much less originated, and an English inventor must get a German or an American workman to carry out his notions. Highly as I think of the conservatism and stolidity of Englishmen, I must confess that all this seems to me to cry out for a reform, whatever may be said in its favour by certain prominent men. England was first in employing her iron and coal, and, probably, she will always be in front of people despotically governed; but she acts like an extravagant rich man in making so little use of her great advantages. Any one who has been among Asiatics, and has seen how a common English sailor, or English workman, develops intellectual powers and ingenuity, and gets administrative ability, when circumstances place him in a position to develop them, must feel what a great waste there is in England, where all this brain power lies dormant, education and surroundings forbidding it to develop itself. We are all acquainted with good reasons for changing the apprenticeship system of England, and not long ago, in this room, a lecture was delivered, the gist of which was that the trade-school system of France and Germany should be planted in this country. I gave my reasons for dissenting from this view at the time, and they have been more fully published in the *Electrician* of the 3rd inst. What is wanted in England is a good system of technical education, so that English workmen may be fitted to investigate the phenomena taking place before their eyes every day in the workshop.

It is possible that for a long time in any scheme of technical education, however good, we shall be opposed by difficulties which are due to educating only one man out of every twenty. An eminent manufacturer used to tell the story of how, when he was an apprentice, he discovered that a little schoolmistress got high wages from his master for translating his French correspondence. He, thereupon began to learn French from this lady, and after some time his master discovered him by his books. The kindly reproof which he administered was worthy of our more modern opponents:—"Eh, lad, tha mun stop that; tha'll never cut an English file if tha muddles th' yed wi' French." He paid for the books and teaching already given, and his apprentice never went on with his studies in this direction. A belief of this kind is too well fixed in the English mind not to be founded on good common sense. Partial education of a few workmen loses them the sympathy of their fellows, and gives them a weak sense of superiority to their work, which is apt to prevent their acquiring those instincts which are so necessary to good workmanship. This state of things will be reversed when the uneducated workmen are in a minority. I might use, as an illustration, the partial higher education of women, which tended, at the beginning, to make them lose their womanly qualities, but the general effect of which is already seen to raise them far higher in this respect than they ever were before.

For reasons given already, I believe that it is possible for children in the primary schools of England to acquire good notions of the principles of natural science, and hence that they will be in a position, on leaving school, to take up the study of technical physics as specialists. Some of these specialists will be called workmen, and some of them, whose parents are richer than others, or who have shown greater ability than others, will, after a course of laboratory work and more advanced study, become foremen and managers. Some will begin their trades at from 12 to 14 years, and others at from 17 to 20 years of age. As the nature of the teaching of physics in primary schools, which seems to me best, has been sufficiently described already, I now propose to consider the more advanced kind of instruction which is to be recommended for boys between the ages of, say, from 13 to 15 and 20 years. Owing to the incomplete training which has, until the present time, been given to boys in schools, English professors have hitherto had to struggle with great difficulties in their college teaching, and, without being supposed to cast on them any reflections, I hope I may be allowed to express the opinion that advanced natural philosophy has not hitherto, in this country, been given a fair chance. Possibly, the teaching of chemistry in some colleges, and of physiology and anatomy in medical schools, quite come up to my ideas of what may be done in physics, but, for an example of a sufficiently good school of physics, we must look to the great laboratory established by Professor Ayrton in Japan. I exhibit photo-

graphs of the natural philosophy department and museum of the Yedo Technical College. I mention the museum, because the five or six rooms in this building, still unused for museum purposes, were taken up by students engaged in physical experiments.

It is easy to understand from the diagrams exhibited to the meeting, how the building specially intended for work in technical physics, is portioned out. [Here the plans of buildings, the peculiar instrument cases, experiment tables, work benches, &c., were explained to the meeting.] I cannot do better than read to you some extracts from an article in the *Japan Weekly Mail*, of October 26th, 1878, on "A visit to Professor Ayrton's Laboratory":—

"Mr. Ayrton conducted us into his large lecture-hall: a narrow gallery, running round not far from the ceiling, and appendages to the ceiling, were, it was explained, for pendulum and other experiments requiring considerable vertical space. The lecture tables are reached by steps at the middle and on the ends of a platform, and these tables are supported on stone columns coming up from the foundations, and they are kept quite detached from the floor; the great peculiarity of the whole laboratory seeming to be, that nearly every table in the place rests on columns of masonry coming up from the foundations and kept detached from the floors and walls, so that instruments resting on these tables may not be shaken by persons walking about in their neighbourhood. Every table in the lecture-hall is supported in this way, and as these tables are higher as they are farther away from the lecture table, it is easy to see that Mr. Ayrton had considerable difficulty in getting his views carried into effect. These firm tables form quite a new feature in lecture-halls, since it is now possible for students to actually illustrate the lectures by their own experimental work; and, besides, a great space is utilised, which, when lectures are not being delivered, must usually be unoccupied. Besides these tables for students hearing the lecture, there are a great many tables round the walls of the room, not raised, and not supposed to be occupied by students attending to the lecture. These tables are of a new kind. It is possible for a student to leave his batteries and wires, his galvanometers, and little temporary contrivances, for, by pulling down a glass door, he shuts out dust and meddling hands. That there is a great saving of time effected by these shutters must be quite evident. We may just mention, that a great part of the apparatus required by the lecturer, or by the student, is arranged in glass cases round the room." . . . . "On looking over the collection of apparatus, much of which, however, was in use all over the place, we felt that neither the Cavendish laboratory nor the Oxford one, nor any others which it had been our privilege to see, could produce such experimental work as might come from this laboratory in Yedo, if only the men to use them were the same. We understood from Mr. Ayrton, that it was possible for any student at any of the tables to turn on a tap of water or of gas (the gas arrangements had not then been completed), or a current of electricity, and that perhaps, in time, he might be able to coax the officials to allow him to convey separately hydrogen and oxygen to all the tables. We confess, however, that we felt more comfortable in knowing that Mr. Ayrton had not been able to carry this point of the explosive gases. Almost all the tables were occupied at the time of our visit, and we were informed that so eager were students to take advantage of the fine arrangements, that some of them, engaged in carrying out important investigations, had many times applied for permission to work after ten o'clock at night." . . . . "Adjoining the lecture-room is a general laboratory, where the *kotskais* get ready apparatus; but here, again, we saw the stone-supported tables, occupied each with its two or more students, who were, we believe, mainly telegraph students, testing lengths of wire and insulators and batteries, using Thomson's galvanometers, with their flashing spots of light, and peg-boxes, and batteries. The telegraph students were in this room where the vices and anvils, and tool-racks, and furnaces were; and some of them were making joints in telegraph wire, and they were all busy, and seemed to like their work, and they were evidently all well up to their work. This is a model work-room, the tool-racks all in that state of completeness which shows constant use and constant attention, the countless drawers each with its label, alphabetically arranged, the cases of apparatus overhead, and the general atmosphere of efficiency would have tempted the laziest of men into using files and hammers, and shellac. I applied one test before leaving the room, and that was not an electrical one; I tried a few of the drawers, and I found that each really contained the copper or zinc, or twine, or sealing-wax, that it was labelled as containing, and there was a good supply." . . . . "I observed in one side passage that students were busy at heat experiments, and in another a great lot of batteries. Mr. Ayrton's private room comes next. Besides its writing-desk, and book-case, &c., it had the inevitable stone-supported tables, with vertical glass doors. Then came a large apparatus room, glass cases all round, a large set of cases in the middle of the room. Then long narrow laboratory which might be darkened, and out of it a small room, called for pre-eminence the dark chamber. In this sacred place were six columns of stone, each standing about four feet above the floor. Two were devoted to a Thomson's electrometer and its scale. This wonderful instrument had been taken to pieces some five times since its arrival in Japan, and it says much for the patience and skill of Mr. Ayrton and his students that the instrument was in good order. It is probable that this is the only specimen of the instrument which has survived even once being taken to pieces in a physical laboratory. I saw that one of the best students was gradually satisfying himself that even the best of these instruments gets intoxicated once a day, and that the proper course of action of its caretaker is to let it alone for a while. Two other columns were devoted to a galvanometer. I understand that there are only two other galvanometers in existence which are as good as the one in question." . . . "Of the remaining columns, one was devoted to an original investigation of the behaviour of twisted wires, and on the other was an apparatus to test a well-known Japanese belief regarding the effect of an earthquake on a magnet.

"Upstairs, a small class-room was used for lectures by such of the senior students as helped the professor in teaching. Next came a long room devoted to batteries. There were some three hundred Daniell's cells in working order, arranged in a glass case, and easy to get at, and many other cells in a clean state. Even to the construction of the troughs for soaking the porous cells and cleaning zincs, considerable thought had evidently been given, that there might be as little delay as possible in cleaning the cells. Mr. Ayrton told me that he had prepared some thousands of small Daniell's cells, each outer vessel being a piece of bamboo, but that the cheapness of the cell was its only recommendation, for a fungus growth of some kind interfered with the working. Beside this battery-room was the workshop, with lathes, carpenters' benches, &c. I found two workmen here, to one of whom a student was explaining something about a template. There were unfinished instruments and working drawings lying about. Beside this was the drawing office; some of the students were making working drawings of instruments, but the majority were reducing observations and drawing curves on squared paper.

"A large room, which seemed devoted to light experiments, with a great heliostat in the window, completed the rooms in the new buildings. But I proceeded to the old buildings of the compound, now devoted to museum purposes. It would take too long to describe fully the telegraph museum, with its specimens of all kinds of telegraphy, posts, insulators, sending and receiving instruments, &c. It is sufficient to say that every instrument was in working order, as one could tell by touching the various keys, when the clicking of the receiving instruments might be heard. Mr. Ayrton printed my name on a slip of paper, on the other side of the room. In some of the smaller rooms of these old buildings we found students working at various investigations in heat, light, and electricity. We find it impossible to imagine that such work has been wasted. If we could share Mr. Ayrton's belief in the great power shown by some of his students, we might believe that a great school of scientific thought has been founded; and although we venture to doubt the existence of sufficient capacity in the Japanese mind for high original scientific work when unhelped, still our visit to this, the finest physical laboratory which exists, perhaps, in the world, has impressed us with the notion that those students whom we saw working, will yet leave an important impression of their own upon the history of science."

The account from which I have been quoting, gives the impression that the experimental work was mainly in electricity, but this was probably due to the visitor having come on a day when there were more telegraph students than others, or, perhaps, the visitor was a telegraph engineer, for experiments were constantly going on in all parts of natural philosophy.

It will be observed from this description, that the great objects which Professor Ayrton had in view, and which, I am in a position to say, were carried out with great success, were that:—1. His elementary lectures could be illustrated to some extent by the students themselves. 2. His students stayed with him a long enough time, and in sufficient numbers, to make laboratory work an important part of the scheme of instruction. 3. He could, to advanced students, make his lectures technical, that is, he could assume a knowledge of the principles of natural science, and show how these principles were employed, not merely alone, but in conjunction with each other in telegraphic engineering, and in other departments of applied physics. 4. His students, without disconnecting themselves from the natural philosophy department, could attend lectures on such parts of technical physics as did not come within the province of Mr. Ayrton himself, mechanical engineering, and applied mechanics of all kinds, &c. 5. Even when students conducted experiments in the engineering laboratory, they were taught to consider themselves as still continuing their researches in natural philosophy. In consequence of all this, probably every one of the great number of workers in the establishment was full of an idea of the importance of the work he was doing, and was constantly becoming more intimately acquainted with the laws of nature. Because of the investigations, which were put in the care of advanced students, being of an original kind of some value to the general world, each such student was really cultivating habits of observation, and a reasoning power which would not easily be destroyed, however much of a routine there might be in his future profession. It would be too much to say that any of our students ever developed a power of originating experiments, because this power can hardly be expected until after the age of twenty, but many of them did pursue work of their own towards this end. Thus I remember discovering a boy striking, one by one, about a thousand matches, half in and half out of a beam of light, to discover the effect of sunlight on a fire; and I have no doubt that Professor Ayrton could give many such instances of developed originality. Our system of getting original work performed was open to the objection that when an experiment had been designed, and students were left to themselves to carry it out, it would often proceed for some weeks without any of the alterations of apparatus which would have suggested themselves to the professor if he had conducted the experiment himself. This never occurred with the more advanced students, however. A striking example of such a difficulty is now in my hands. From a notion of getting minimum distortion at all points in a map, a method of drawing it was arrived at, and two students were asked to carry out the idea. It was only after a month's quiet work that the elaborate descriptive geometry method of projection, which these students employed, was found to give the same results, and to be, in fact, identical with well-known stereographic projection. It is needless to say that the discovery would have been earlier made by the professor, if he had been engaged on the work himself.

Now, all this sort of teaching seems to me perfect as the beginning instruction in technical physics. To begin, so to speak, in the middle of the subject, to make students acquainted with natural philosophy through their own experience of instruments and machines, and of substances subjected to various operations. For we found that such students worked up all the early parts of natural philosophy with some earnestness after they got to have a knowledge of the matters to which more elementary studies gave an explanation. It will at once strike everybody that such students as these had very little difficulty in understanding lectures upon manufacturing operations and machines, and that on entering actual workshops they became expert workmen in much less than the usual time.

I hope that nobody will say that in all this I have been merely describing the teaching of pure physics, and that technical physics is quite a different matter. The fact is, it is impossible to say at what period such students as those of Mr. Ayrton began their technical education. Taking, for instance, telegraph engineers. I am quite sure that these students saw no sudden break in the nature of their teaching; it was all technical from the day when they first, with a small but pretty exact knowledge of elementary physics and mathematics, and practical geometry and drawing, took up work in the laboratory. I am sure, also, that no mechanical engineer saw any break in his course until he left the college for workshops. He went about from Mr. Ayrton's lecture-room and laboratory, to the drawing-office and lecture-room and workshop-laboratory of the professor of applied mechanics, and to the lecture-room of the experienced instructor who taught him the theory of certain mechanical operations, such as welding, chipping, filing, turning, rivetting, and the like; but all

the time he knew he was learning how to apply the principles of natural philosophy to the affairs of his future profession. But he is learning much more than this, for all his laboratory experience has taught him that the explanations he hears of the behaviour of materials under strain, of molecular actions when metal is cut, are incomplete, and he has learnt that he is in a specially good position for making it more complete. He has learnt that no machine or instrument in use is perfect, but may be made better if he bestows thought upon every detail of its construction. He has learnt to imagine what is actually being done in each operation which he may be put in charge of in the workshop, and knows that it is in his power to get that operation performed in a better way. He has learnt, too, that great patience and quiet thought are necessary if he wants to study well any phenomenon that comes before him. I consider that such students as these have got all the benefit which it is possible to get at a technical college. Their further study is that of specialists. They must teach their hands and eyes in the manufactory, and read what is written by other men who have been in the same position as themselves, but their education can only finish when they cease to work.

Let us now consider how common workmen shall learn to apply the principles of physics to their trades. Either through their early training, or from science and art classes, we are to suppose that workmen of the future will have a knowledge of practical geometry and mechanical drawing, they will know elementary natural science, and, perhaps, a little algebra and trigonometry. If they are suddenly thrown into a factory, to make materials obey their wishes, and see how other men do their work, I consider that to teach them the applications of their previous knowledge will be easy enough, if only we can provide for them teachers and school-rooms near their factories. For it is to be observed that, of technical class-books for such students we have plenty already, and of illustrations of the instruction they get their factories are filled. We may be quite sure that school-rooms will not be wanting when the teachers are ready, and the only teachers worth having are men who have been trained in an establishment like that just described, and who have also passed through the factory.

Passing from this great question of the future to the present necessity—what is to be done for workmen just now—men, one out of every twenty of whom has attended science and art classes, but who may be looked upon as knowing little or nothing of the elementary principles of physics? They are experimenting among the most complicated phenomena, and we must teach them to understand what they do and see. Now, the standing rule in teaching is that we ought to use, as illustrations, those things with which pupils have most to do. Here then we have to follow the idea already sketched out; we must begin somewhere in the middle of our subject, working both backwards and forwards; and, as I said before, it really does not much matter where we begin. This kind of instruction is still in its experimental stage, or rather experiments have just been begun in it. If, as a result of experiment, we were able to tell what is the best way of teaching apprentices and workmen, if we could write out a regular programme for each trade, and could say that it is good, I am quite sure that the establishment of schools all over the country would be the work of a few years only. It is all very well for us to blame English manufacturers for not educating their apprentices, but we do not see the magnitude of the work which we propose to them. How often have learned professors given short courses of lectures to working men; how many classes have been established in mechanics' institutes and elsewhere; how much work of this kind has been tried we all know, and with what want of fruition. All the experiments have given more or less unsatisfactory results. One reason for this is, that possibly no able physicist has cared to study patiently the question year after year, varying his method of teaching to find the best; another is that the matter has never yet been taken up on a large enough scale, so that, for instance, one class might be formed of students who are in anything like the same condition for pursuing their studies; and lastly, there has been no way of compelling or inducing everybody to continue his studies for two or three years. For the great central difficulty in such an experiment is that the services of the teacher, and the attendance of the students, have always been voluntary. A little want of patience on either side, and the experiment ceases. That a competent man be induced to continue his experiment for several years, provided he is assured of his pupils coming to him in a certain state of preparation, and also of their attending with fair regularity for several years, these I look upon as conditions of more importance than any others if the experiment is to prove successful, in telling to us what is the best scheme of education in technical physics for workmen. I lay some stress on these necessary conditions just now, because I have studied carefully the method of teaching which Mr. Ayrton is employing for the City and Guilds of London Institute, in his lectures on "Applied Physics," at Cowper-street, and I think that this method promises more success than any other which I have heard of; and I fear that it will fail, on account of the above conditions not being carried out. His method is succinctly stated at the end of his syllabus;—

"The aim of these lectures on technical physics will be to train the students, by an examination of the machines, instruments, &c., employed in the arts (or of models of them), to turn their attention to the scientific principles governing the action of these machines, without a knowledge of which neither their proper working can be ensured nor improvements in them effected. It is believed that the analytical method of experimental instruction, in applied physics, will, for the class of students expected to attend, be preferable to the ordinary method adopted in the teaching of natural philosophy, which consists in much time being spent in the study of the elementary principles, and then only subsequently the practical applications explained."

Perhaps his meaning will be better understood if I read a paragraph from his syllabus—

"*Variable Rate of Going*—All watches gain or lose: chronometers gain or lose uniformly, ordinary watches have a variable rate; acceleration; retardation, brakes, compressed-air brakes, vacuum brakes; effects of heat on the springs of a watch; compensations; the vibra-

tion of balance wheels and of pendulums are examples of a uniform gain of speed; is the result of a constant force acting; Newton's second law of motion, methods of proof, &c."

It is to be understood that he is taking up, more particularly, in these lectures, the principles of watch and clockmaking, and it will be seen that he reasons from that part of the subject which his students know, namely, from the appearance and uses, and construction of the various time-keepers shown to them, backwards (or forwards), to those mechanical and physical principles with which most men begin to study a technical subject. In doing this, he makes use of all the knowledge and habits of thought which he supposes workmen to have, illustrating his lectures by means of experiments. Mr. Ayrton then goes on the principle that we may begin to teach physics at any point we please, so long as our students are thoroughly convinced (or can become convinced by examination and observation) of the truth of the data with which we begin. He here begins by showing clocks and watches such as everybody has seen. Everybody knows that they are time-keepers, and that they need to be wound up, and that they gain or lose on each other slowly, and he works on this basis until he has traced out clearly all the physical principles involved in his subject.

I say that this is the most promising method I know of, but it will undoubtedly fail to give satisfaction, unless the scheme of technical instruction at Cowper-street is large enough for the proper carrying out of any such experiment. It has been proved, over and over again, that trifling fugitive experiments of this kind are of no use whatever, and, indeed, the more promise they show at their inauguration, the more harm they do when they prove unsuccessful, for it is to be remembered that the result of the failure of an experiment is the disheartening of students, clinching the opinions of the many opponents of technical education, and losing the sympathy of manufacturers throughout the kingdom. We have already had more than enough of these unsuccessful experiments, begun with enthusiasm, and ending rocket-like in burnt-out sticks.

DISCUSSION.

The Chairman said they must all thank Professo Perry for the very interesting paper he had read They had seldom had the opportunity of hearing a comprehensive scheme of education worked out in so careful a manner, and the principles enunciated so clearly, as had been done by Professor Perry. It was, no doubt, a scheme which varied considerably from any now available for artisans, but it was perfectly certain that our system of education must be improved if we were to keep up and advance in competition with the rest of the world. The Americans succeeded better in inventions and improvements than we did, because all their surroundings tended to create the feeling of the necessity of improvement, whereas ours made us rather adverse to change. In England any invention was looked upon as something which would probably be an injury to the community, whilst in America every invention was hailed as something which would confer a benefit. The reason was very simple. Here we had an abundant and ill-educated people, and there they had a sparse people who required every labour-saving appliance in order to enable them to succeed in life. At the present time there was the prospect of a large scheme for technical education being brought forward by the City Guilds. It had been under consideration for some time, and recently, in that room, Professor Huxley had said that he thought they were a very long time about it, and he wished they would exert themselves more speedily. It must be remembered, however, that the question was a very large one, and the expenditure involved very great, whilst a false step might lead again to failure. He, for one, was not quite certain that it would be wise for the City Guilds to establish their college at South Kensington. First of all, he did not think it advantageous to be too much under the influence of the Government, and in the next, the land occupied by the Commissioners was surrounded by houses in which it would be impossible for those who would frequent the college to live; they would have to go to considerable distances in order to get accommodation suited to their means, and this would be a great disadvantage. He hoped there would be a good discussion on this important subject.

Mr. E. C. Robins said he had rarely heard a more interesting paper, but he should have been very pleased if Professor Perry had shown the plans of the buildings referred to, or if, at some future time, the particulars of those buildings were made known. He had had the good fortune to see them in Mr. Ayrton's possession, and they were so valuable as examples of the kind of fittings suitable for physical laboratories, that it would be a good thing if people, and architects especially, were more informed about them. Those details ran over a large number of sheets, and were exceedingly well conceived, admirably designed, and deserved to be published. At the present time, when arrangements were being considered for teaching physical subjects, no better service could be rendered to the public than to have the details of fittings, most useful in carrying out experimental teaching, made known. Owens College, Manchester, was, perhaps, the best example as yet of a chemical laboratory. That had been specially illustrated, and an account of it might be purchased, and if they could also have the details of the physical laboratory at Yedo, it would be extremely valuable. With regard to the teaching of physics generally, it was becoming much more popular; in fact, all scientific teaching was becoming more and more popular and necessary. It was creeping into elementary education, and secondary education must follow, because it was necessary for each class to keep its own ground in competition with the one immediately beneath it.

Mr. H. Trueman Wood (the Secretary) said the Society was very fortunate in having heard Professor Perry's paper, because a short time ago they had a singularly able paper from Professor Thompson, in which he set forth the other side of the subject. He thought that the two papers might fairly be taken as representing the two great divisions into which the subject of technical education divided itself. The more one thought about technical education, the more one saw that there were only two ways in which it could be followed out. One was by taking the young student or apprentice and teaching him his trade thoroughly; teaching him the mechanical manipulation of his business; in fact, teaching him as a boy the processes which he would have to carry out in his work. The other plan was to give the young man a thorough teaching in the scientific principles which underly his work, and to leave him to learn in the workshop the mechanical dexterity, in which he had yet to learn that English workmen were at all behindhand. The more he considered this subject, the more he came to the opinion that it was only in the workshop that a man could learn his trade. It was by a sort of intuitive, unconscious imitation that he acquired what was most useful to him to know. He watched the com-

petent workman doing his work, he unconsciously imitated his movements, and, before he knew he was learning anything, he became able to accomplish the same results. They had heard so much of the technical institutions which had sprung up since the beginning of the century in France, Germany, Russia, and America, that he thought some of the most ardent advocates of technical education were too much inclined to imitate them. For that reason, he thought the experiment now being carried on at Cowper-street, might, if successful, be very valuable, being an experiment in the opposite direction. Here he might be allowed to differ from Professor Perry as to the value of such attempts. It was only by such tentative experiments that we could really find out what we had to do. This was a new question, and it did not do to get hold of some preconceived idea, and cling to it, supposing nothing else would do. It was only by trying one thing after another we could really find out what it was the industries of our country needed. At Cowper-street an attempt was being made to give to workmen, as far as possible, some instruction in the sciences upon which their trades were founded. The main difficulty in doing this was, to begin with, that you could not get a class of any one particular trade. At this moment, at Cowper-street, they had classes in which a number of trades were represented, and the great difficulty was to give the sort of teaching which would be useful to each one, and yet not so special as to be useful to only one, or to some few trades alone. As time went on, it was to be hoped that those who had the work in hand would gradually find out what it was each trade wanted, and so be able to divide the present single class into a great many classes, and that the workmen who came there and found they really were learning something, would go away and tell their comrades, and then they would come from each separate trade, and classes could be formed for each of the many industries carried on in that part of London. One great thing which they had to teach workmen was not to look for results too soon. A workman went to a science class, and found that, after having studied a few months in geometry, he was not able to build any better, or perform better the various manual operations in which he was employed; but if he had only patience to go on for a few years, instead of a few months, as all had to who acquired any theoretical knowledge whatever, he would find that he was unconsciously applying the principles he had learned. We must be content at first to get hold of a few men and teach them something of which they could not learn the advantage all at once; but they would gradually find out that somehow they had acquired knowledge, that they became more skilful workmen, had better chances of obtaining employment, and, above all, could get better wages. When we had a few such men as this, the best men in the same class would follow their example, and, in the long run, we might hope to attain what was really the object of the movement—to get a race of workmen who, instead of being content to do what Professor Perry had so well said was, after all, better done by a good machine, would put their minds into their work, and so help on the country in the race with others. This was done to a great extent in America, although he believed that the extent to which it was done was much exaggerated. They would all remember the story which went the round of the papers of how Professor Bell, the inventor of the telephone, was obliged to leave England and go to America because he could not find here workmen able to carry out his designs. He could only say that if Professor Bell had availed himself of the resources of one of the largest electrical factories in this kingdom, which was freely placed at his disposal, he need not have gone back to America, but would have found men perfectly capable of carrying out any of those marvellously beautiful inventions with which he had astonished the world. It was too much the fashion to run down our own workmen as compared with those of America and Germany. To come back to the point with which he started, he did not think the way to get a superior class of workmen was to establish a number of apprenticeship or trade schools, such as those of France or Germany, or, the most recent of all, the Massachusetts Institute of Technology, at Boston; but to go on in the way in which the City Institute had begun at Cowper-street, and in which he hoped it would go on, as soon as it saw its way clearly, to establish that great institution for technical training for which they were all anxiously looking. If they could only get the workmen to learn the facts which were now being worked out for them by the many scientific workers—in whom England was as rich as any other country in the world—the object would be attained.

Mr. Owen Roberts said he had listened to the paper with great interest, and he thought it extremely fortunate that they had, in Prof. Perry and Mr. Ayrton, Englishmen who had been exercising their minds on this difficult question of technical education in Japan in so practical a manner. The experience they had worked out for themselves must be valuable to us in feeling our way in this difficult question. He knew very little about the subject himself, but was very anxious to learn, and he had endeavoured during the last two years to learn something, feeling that, in his position, as honorary Secretary to the City and Guilds Institute, he was bound to know as much as he could about it. It appeared to him that this question was very much dependent on the elementary instruction in science and art, which ought to be given to the youth of this country in the primary schools, and that the basis of the difficulty lay there altogether. He would cheerfully pay any rate, educational or otherwise, to afford to the people of this country what he thought they primarily wanted—a solid, simple, elementary education in science and art, prior to the time when they commenced their apprenticeship. They all knew how difficult it was, when one had left school or college, and gone into the practical work of life, to take up theoretical instruction. Even the student reading for the bar in chambers at the Temple paid little attention to the theoretical principles of law, but studied case law and Court practice; apprenticeship, in fact, was practised in the law as much as anywhere else. It was very difficult, when one had begun the real work of life, to go back and practise the docility of earlier years. He should like to see science and art taught in the Board schools, and that whenever there were special industries in particular localities, education should be directed to those branches of science and art which bear on those industries. He could conceive nothing better in an agricultural district than chemical explanations of manures, soils, and other matters, taught in simple language, for when the boys began to be employed in the fields the lessons they had learnt would find their practical illustration and application, and he felt certain that in a generation hence we should have a very different class of agricultural labourers. These men were sometimes spoken slightingly of, though his experience was that they were sometimes far more acute than those who patronised them, and he believed if they only had a fair chance in early life they would bring the wits which all English boys possessed, no matter what their station in life, to bear upon what was before them. He wished, too, there might be some mode by which scientific instruction could be systematically given during apprenticeship. The old seven years' apprenticeship must be remodelled. There ought to be a Commission appointed to report upon the whole system, and modify it. When the system was introduced, industry was in totally different conditions, but we were a very conservative people, and found it difficult to move out of an old system which was really designed for different industrial conditions. He should like to see a system of half-time

or quarter-time, whereby the apprentices could have science or art instruction during part of the day, spending the rest of the time in the workshop, where the master, who should himself be a practical man, might be at their elbow, so as to teach them the scientific bearings of their work.

Mr. W. Coffin said any one who knew anything of the principles underlying the elementary teaching of children in the kinder-garten school, and the intentions of Froebel and the other founders of that method, must be much struck with the clear way in which Professor Perry had stated the principles which, perhaps unconciously to those founders, underlay some of the practical parts of that system. In this country there was some misapprehension on that point, it being generally thought to be a mystic idealism which originated the kinder-garten system, but it was really seen many years ago that children, like many child-minded adults, in unknown subjects, reasoned more about things than ideas, and very easily accepted generalisation even of a very broad character. It was found that children, when approached upon any branch of physics which fell directly under their young fresh senses, immediately absorbed and appropriated to themselves unconsciously very broad generalisations, and that this gave them an abiding interest in the details of fundamental principles which, if placed directly before them at first, they would be unable to understand or appreciate. It was somewhat singular that this method of instruction was more popular in America than here. Reference had been made to some distinctive difference between the American technical instruction and English, and, therefore, as an American, he might be excused for saying a word or two on the matter. In America, object teaching had been incorporated very largely indeed into the State elementary education, the result of which was that children going at an early age from these schools, by no means well versed in art and science, as was rather grandiloquently advised by some, but, on the other hand, saturated with an interest in phenomena, and with an appreciation of their real meaning, and a power of mind to carry on investigation, these young people were not forced into technical schools where they were obliged to pursue a line of study for which their minds were not capable. On the other hand, they went into the rough and tumble of life, and, after they had taken up, according to their opportunities, such trade or occupation as they might be led into, they were then much more inclined to seek the higher technical instruction, which might be presented to them. Mr. Wood had alluded to the disinclination shown by workmen of various trades to seek the advantages offered them in technical training, and that very much arose from the fact that their minds had never been trained to such studies. The Technological Institutes which were now springing up in America were taken advantage of, not so much by young men as by those of middle age, who felt the need of further instruction; men capable of a good deal of original work, as experience proved. The result of that was, as must be admitted by all who had seen the corresponding trades in the two countries, a greater advancement in *technique* and in technical knowledge than existed here; though he must, as an American, bear witness to the fact that for solidity, pains-taking, and patience, nothing could be more admirable than the work of the British mechanic. He must say that an equal amount of patience must be exercised by those who sought their services, and he thought it would not be derogatory with the technical skill which must be acquired in the workroom, if this higher knowledge of the principles underlying their work was brought before workmen at a later period. There was some truth in both sides of the question, both that advanced by those who would merely open advantages to workmen after they had acquired their trade, and those who would begin with technical education. In order that a workman might excel in his trade, there was physiological and psychological dexterity which must be acquired—that automatic reflex action, the more intricate and complicated co-ordinative movements which, if not acquired, rendered the best organised brain and the finest intellect perfectly incapable of attaining that machine-like accuracy which only practice from an early age would give. Therefore, in the elementary schools, an interest in investigating phenomena should be developed; and then upon it should follow the usual general education fitting them for life, and after the mechanical part of their trade had been acquired, they would seek more readily, and be better able to appreciate and take advantage of such technical instruction as was to be afforded them at the Cowper-street schools.

The Chairman said it was prominently urged, and was no doubt perfectly correct, that the facility for progress in technical education lay in the foundation having been laid in the elementary schools, but this would imply that the education in each primary school should be adapted to the requirements of the particular district. That, of course, implied that the regulations by the Government Department which superintended education should be much more elastic than they now were, and it also rather pointed to the consideration whether it was desirable that school inspectors and the officers of the Privy Council should be brought up under a purely classical system of education, or whether it would not be better that they should have been trained in science. The Privy Council Department consisted practically of two branches. There was the Educational Department, as it was called, and the Science and Art Department, and he did not think they would ever get a proper code of education in the elementary schools until both these were merged into one, and a much more elastic system adopted.

Professor Perry said he would remark, with regard to what Mr. Coffin had said, that the circumstances of England were quite different from those of America. American workmen were thoughtful about their work, because circumstances had forced them to be so, whilst English workmen were not forced in that way. He did not see that we were called upon to imitate Americans in any of their institutions any more than we had already done in our primary school education. Nor did he think so much of the technical schools of America. We had to work out experiments of our own in this country. With regard to what the Chairman had said about the college at South Kensington, he would refer to the *Electrician* of January 3rd, in which he had stated his views with regard to the carrying out of the proper system of technical education in England. Two kinds of colleges were needed. One such as had been established by the City Guilds at Cowper-street for workmen and apprentices, and also, perhaps, for training boys who were to become apprentices. But there was also another kind of college needed, and it was with reference to a college of that kind that he spoke principally of this establishment in Japan. Such a college as that might be established at a place like South Kensington, because it would be chiefly attended by the sons of manufacturers and rich men, and by those who had received scholarships or prizes on account of their superior ability, and he did not see why it should not be established in such a locality. If it were established anywhere in London, it would be difficult for students to reach it easily, and it might as well be at South Kensington as anywhere else. With regard to what Mr. Robins had said, he regretted he had not had time to describe more fully the arrangements of Professor Ayrton's laboratory, but he was quite sure that his drawings were at the service of anyone who wished to study them, and ascertain what were the arrangements necessary for a large physical laboratory.

A vote of thanks to Professor Perry concluded the proceedings.

EIGHTH ORDINARY MEETING.

Wednesday, January 28th, 1880; JOHN T. BEDFORD, Esq., Chairman of the Epping Forest Committee, in the chair.

The following candidates were proposed for election as members of the Society :—

Kennard, James, F.R.G.S., Morton-house, Middleton, Lancashire.
Ness, James Sharp, 265, Camden-road, N.W., and 21, Milk-street, E.C.
Paine, Cornelius Henry, 1, Harley-place, W.

The following candidates were balloted for and duly elected members of the Society :—

Andrews, William, 16, Telegraph-street, E.C.
Boldero, John, jun., Norfolk-house, 3, St. John's-wood-road, N.W.
Boult, Alfred J., 323, High Holborn, W.C.
Cole, Granville, Ph.D., 31, Lombard-street, E.C.
Cole, Vicat, A.R.A., Little Campden-house, Kensington, W.
Eckstein, William, 43, Scarsdale-villas, Kensington, W.
Fenner, W. H., Beckton Gas Works, North Woolwich.
Foreman, Ernest, 1, Gresham-villas, Stanstead-road, Forest-hill, S.E.
Hunter, Major C. F., Lawn-cottage, Chipping Barnet, Herts.
Leveson, Edward John, Anerley, S.E.
Merryman, William Henry, 118, Ledbury-road, Bayswater, W.
Payne, Everett Jesse, Messrs. John Hall and Co., 79, Cannon-street, E.C.
Perry, The Right Rev. Lord Bishop, 32, Avenue-road, Regent's-park, N.W.
Reay, Lord, 6, Great Stanhope-street, W.
Rose, George Daniel, 28, Page-street, Westminster, S.W.
Russell, Thomas, F.R.G.S., Haremere-hall, Hurstgreen, Sussex.
Shaw, John, College-place, Derby.
Shean, Arthur William Charles, F.R.G.S., 18, Finsbury-circus, E.C.
Thomson, James Duncan, St. Peter's-chambers, Cornhill, E.C.
Turnbull, Alexander, 118, Belsize-park-gardens, N.W.
Wood, John Denniston, 82, Ladbroke-grove, Notting-hill, W.
Wood, Thomas, Stafford.

The Chairman said, this being a subject in which he had taken a deep interest for some years, he should be much pleased to hear Mr. Paul's views upon it, because he had given a great deal of time and attention to the subject. He (the Chairman) was the fortunate individual who induced the Corporation, some nine years ago, to take up this great question, and, after a hard and desperate battle, since it affected land worth a million of money, the Corporation succeeded in preserving this magnificent recreation ground for the people of this large metropolis. He had known the forest pretty well in the past, and also knew it pretty well in the present, and he should be glad to hear some ideas how it should be treated in the future. It was the wish of the committee to make Epping Forest one of the most magnificent places in Europe, not by destroying its character, but by developing those beauties which existed there to so large an extent. They meant it emphatically to remain the forest of the people; not to be made a park. This, no doubt, they would be able to accomplish, with the aid of the good advice they were constantly receiving, and with the help of their superintendent.

The paper read was :—

THE FUTURE OF EPPING FOREST.

By William Paul, F.L.S.

The subject I have the privilege of bringing before you this evening is "The Future of Epping Forest: How shall Epping Forest be dealt with?" It is consigned to the Corporation of the City of London, "for the recreation and enjoyment of the public," the details of arrangement being left largely in the hands of the Conservators, who have accepted a trust of no mean magnitude and importance, the fulfilment of which is sure to be narrowly watched and freely criticised. I must, at the outset, beg of you to consider the remarks I am about to make as suggestive rather than exhaustive, as dealing with the general rather than the particular; for I conceive that this, if not the only way, is at least the best way in which the subject can be handled before a meeting like the present. Nay, I would go further, and assert that no precise or definite rules can be given, as regards the execution of details, which might not be advantageously broken through or ignored under varying circumstances. There is here an unrestricted field for the exercise of taste and genius, and those great qualities of the human mind must not be "cabined, cribbed, confined" by rules.

Although thoroughly acquainted with every part of the forest, having, in early life, traversed its open spaces on foot "from morn till dewy eve," and searched its glades and thickets for the numerous and varied botanical treasures which they contain, I yet approach the subject with diffidence, so many features of interest and importance, *in esse* and *in posse*, presenting themselves which it would be well to develop, create, embody and maintain. It will, however, clear away a host of difficulties if we keep in view the fact that the Act of Parliament declares that Epping Forest must remain a forest; it must not be converted into a garden, an arboretum, or a series of arboretums; a park, or a series of parks; in imitation of the many beautiful, but comparatively restricted surroundings of the residences of our English nobility and country gentlemen; no! it must remain a forest. On this ground, therefore, let us take our stand, and consider the subject from a forestal point of view. But, in taking up this position, it must not be inferred that I am about to advocate the view that the forest should remain as it is; on the contrary, while holding that here "the great materials of the scene are provided by nature herself," I am of opinion that a certain amount of overhauling, sorting, rejection, importation, and re-arrangement is necessary. The forest should be studied piece by piece, looked at and dwelt upon with the eye of the painter and the soul of the poet, the whole being kept constantly in view that the outcome in the end may be utility, grandeur, picturesqueness, variety, and harmony.

Before proceeding further, it may, perhaps, be well to give a tabular view of the line of argument which I intend to follow, in order to place my opinions on this question distinctly before you.

(*a.*) The Forest proper (unenclosed) :—
1. Scenery.
2. The ground.
3. Roads, rides, avenues, and paths.
4. Turf.

5. Water.
6. Clearing and planting.
7. Trees.
8. Shrubs and plants.
9. Animals and birds.

(*b.*) Recreation grounds (enclosed).
(*c.*) Lodges.

1. *Scenery.*—One of our best writers on landscape remarks that "the forest, like other beautiful scenes, pleases the eye, but its great effect is to rouse the imagination." The scenery of Epping Forest, as a whole, is hardly of a character that can be correctly spoken of as sublime, or beautiful, although beautiful spots may occasionally be met with, and it possesses the elements of both picturesqueness and grandeur. But there are no mountains or torrents, no frowning precipices, no furious eddies, no foaming cascades. It would, perhaps, be correctly described as a tract of woodland and pasture, the surface broken into hill and dale, interspersed with a few fine trees and groves; the old trees possessing a rare and glorious beauty, but not being numerous or prominent enough to impart dignity to a forest of 6,000 acres. It is *picturesque** from its natural ruggedness; it is grand from its extent. These two forms or expressions of beauty, picturesqueness and grandeur, which are inherent, should never be lost sight of, or suffer diminution at the hands of the improver. The former is capable of a pleasing and almost indefinite expansion—variety, the chief present want, may, from the great extent of the forest, be introduced without compromising its grandeur; the latter may be heightened by opening up more distinct views of the largest trees, the handsomest of these being left standing, as individuals or in groups, by clearing away the brushwood which surrounds them. Extreme caution should, however, be observed in moving from these to other forms or species of beauty, and I should scarcely think it safe to introduce any that are not already visible and pronounced, or for which there are not special natural advantages.

> "Great Nature scorns control; she will not bear
> One beauty foreign to the spot or soil
> She gives thee to adorn; 'tis thine alone
> To mend, not change her features."

2. *The Ground.*—From my knowledge of the ground, I feel little hesitation in submitting the opinion that no improvement adequate to the outlay could be effected by extensive alterations of the surface. Here and there, doubtless, there may be holes to fill in, and ugly knolls to reduce or modify, but the general surface of knoll and glade, of dingle and dell, should, in my opinion, remain undisturbed. The scenery of Epping Forest is, as we have already said, of a quiet English pastoral character, and such it should remain. There are no mountains to awe, as in some of our northern forests, no rocky surprises, and to attempt to realise such could result in nothing better than a feeble imitation of the sublimer scenes of nature with which most of us are more or less familiar. The woody knolls, the deepening glens, the free air of the glades and open spaces when these are agreeable, and the shade of the monarchs of the forest when the fire-king rejoices in the meridian, should be sufficient to content us, as they offer no mean opportunities of recreation and enjoyment, altogether independent of greater irregularities of surface. I would not, therefore, attempt to alter the surface of the ground. Draining, however, is a very important matter, and this should, I think, be sedulously attended to. A single visit to the forest would satisfy anyone on this point. At present, it is impossible in winter, or even after rain in summer, to walk any distance without encountering bogs or wet places, which not only interfere materially with the free progress and comfort of the pedestrian, but, by entailing the consequences of wet feet, may prove prejudicial to his health. One of the first efforts of active labour should be to lay the wet places in the forest dry. If bogs must be preserved, for the sake of the aquatic or semi-aquatic plants which grow in and around them, let them be few in number, and in positions where they will not interfere with the enjoyment of the public.

3. *Roads, Rides, Avenues, and Paths.*—It may seem scarcely necessary to dwell on the importance of wide, dry, solid roads through a track of land which, from north to south, is some twelve miles in extent. There are, however, some of the most interesting parts of the forest situated at some distance from the present carriage-roads, which it might be well to open to the view of invalids and those who are past the period of life when walking is one of the ordinary sources of recreation and enjoyment. Rides (for saddle-horses only) would also be a most useful and enjoyable feature in any scheme, and could be worked out at no great expense. Whether of grass or sand, they should be sheltered and shady, and these conditions may be secured by the formation of vistas and avenues. Sir Joshua Reynolds, in a letter to Gilpin, remarked, "You are certainly right in saying that variety of tints and forms is picturesque; but it must be remembered, on the other hand, that the reverse of this—uniformity of colour and a long continuance of lines—produces grandeur." This is, doubtless, correct; in a small track of land, however, the two are exceedingly difficult to combine, but when dealing with thousands of acres the task is easy and the change pleasing. On this ground, I should recommend the introduction of avenues — sparingly, it is true, and they must have a reason for their existence, a purpose to serve, or there must be objects to be reached through them. Avenues afford a fine opportunity for the introduction of rides, but they should not be in too prominent a position, and should be upheld or supported by being placed in immediate contact with large breadths of forest woodland. Walks or paths innumerable already exist, many of them, probably, rights of way, others, which are but little used, seem to be merely short-cuts from point to point. These are, for the most part, in a state which admits of great improvement by clearing, mending, and draining. Not that I would advocate the clipping and levelling met with in garden hedges and walks, but there should be no hindrance to the free passage of the pedestrian; this accomplished, the more intricate, the wilder, and more varied the surroundings the greater the enjoyment. Although recommending the open-

* By the word picturesque, I wish to be understood that which is rugged, varied, and indefinite, as opposed to the smooth, monotonous, or precise.

ing of parts of the forest by roads, the formation of rides, and the clearing and mending of paths, a jealous watchfulness should be exercised over their multiplication; there should be good and strong reasons for every new road, ride, or path, as a needless or useless repetition of these would deform or impair the grandeur of the forest.

4. *Turf.*—Green, soft, springy turf is so agreeable to the eye, and so pleasant to the feet in summer, that it is well worth the utmost consideration. In London, under the most skilful management, it seems impossible to have turf in good condition for more than four months out of the twelve, but here it might be had in a perfect state throughout the whole year. And this need not be a tedious or costly matter, for it might be had, beautiful to the eye in a single summer, by sowing properly-selected seeds in the spring, and it would become closer and more solid year by year. There are already many such green spots, which require little more than drainage to make them enjoyable, and they should be increased in number in suitable positions as opportunities occur.

5. *Water.*—The life and importance which water gives to forest scenery is so great that it ought to abound everywhere. I am not prepared to say what is practicable under this head; that must be the work of the surveyor and engineer; I can only say what I think is desirable. I know that there are springs, and ponds, and brooks in the forest, and I should suppose that, by the aid of reservoirs much might be accomplished in this way without any extravagant outlay. It would be a great achievement if only some of the valleys and hollows could be filled with water. A river or running stream, with cascades, fountains, and waterfall, may be impracticable; but surely lakes, or other natural devices, as regards the management of water, might be wrought out satisfactorily, and such, with water-plants and water-fowl, are always a telling feature in rural scenery. Epping forest, from the nature of its surroundings cannot have its Loch Lomond or its Ullswater, but there is no reason why it should not have its lake. or lakes, which, if partaking less of the sublime, need not be less picturesque, and may, by the power of art be made strikingly beautiful.

> "If distant hills be wanting, yet our eye
> Forgets the want, and, with delighted gaze,
> Rests on the lovely foreground; there applauds
> The art which varying forms and blending hues
> Gives that harmonious force of light and shade
> Which makes the landscape perfect."

Whatever may be the forms of the lakes, they should be natural, irregular in outline, and of considerable size, however few in number, to be in accord with the character and extent of the ground with which they are associated. "Mere form will only give content, not delight—that depends upon the outline, which is capable of exquisite beauty; and the bays, the creeks, and the promontories, which are ordinary parts of that outline, together with the accidents of islands, of inlets and of outlets to rivers, are, in their shapes and their combinations, an inexhaustible fund of variety."*

6. *Clearing and Planting.*—With regard to the future of Epping Forest, I am of opinion that, while we do not want to change the forest into a landscape garden, or a garden of any kind, we yet want the experience and skill of the landscape gardener to clear away the superabundant rubbish now painfully prominent, while scrupulously preserving every visible or hidden rudiment or germ of beauty in which his practised eye and mind may discern a capacity of extension and development. We want also his taste to preserve us from incongruity, and his invention, that we may be free from the insipidity of imitation and repetition. I would, in the first instance, preserve every tree and shrub that is worth preserving, merely clearing away what was unmeaning, unsightly, or ill-placed, reducing confusion to order without destroying variety or intricacy, in doing which there is room for the exercise of the most correct taste and the most mature judgment. This much accomplished, the horticulturist should step in, to make the most of the existing trees, and to add such, native and exotic, as may seem desirable. Many of the former are at present but poorly developed, and others have been injured, beyond recovery, by reckless lopping. With regard to these pollard trees—the result of lopping—they are, I think, for the most part, formal and uninteresting. But judicious pruning and thinning would, in a few years, add many feet to the stature of the *unpruned* trees, and do much to convert the present vast tract of monotonous wood and waste into a veritable and beautiful forest.

We now come to a very important part of the work in hand—planting—with regard to which there is likely to be a great diversity of opinion. The ground I take up is, that trees—wood and lawn—single trees, groups of trees, groves, avenues, thickets, interspersed and relieved with open glades and wide stretches of pasture, are to be the grand distinguishing features of Epping Forest in the future.

Gilpin remarks that "it is no exaggerated praise to call a tree the grandest and the most beautiful of all the productions of the earth." Now, Epping Forest differs from most English forests, inasmuch as its soil is generally highly favourable to the growth of trees. There is, in fact, every description of soil—sand, gravel, peat, loam (light, medium, and heavy), and clay—so that the requirements of almost every tree and shrub may be met and satisfied. A certain amount of planting is doubtless necessary, and it is highly important here that the right trees should be put in the right places, and in the right soil. They should not be planted in formal clumps or groups, but thrown together, in suitable positions, in large irregular masses, the outlines, so to speak, being broken into bays and promontories. If we clear away, we must, in some instances, replace—the forest must be clothed—and with what shall we replace? The answer to this ques- such exotic trees only as are known to endure the tion is, any or all the British forest trees, and rigours of an English climate. While preserving the general character of an English forest, I would not altogether eschew those exotics which are thoroughly hardy, but rather seek to introduce such for the sake of grandeur and variety. If not indigenous, many such are at least familiar, and, from long and extensive use, rank among the established trees of the country. Among the exotics we would include the most ornamental species of the middle and north of Europe, many of those in-

* Whateley.

digenous to the east and west coasts of North America, and some of the Himalayan, Californian, and Japanese species. It is, however, well known to horticulturists who remember the effect of the winter of 1860-61 that some of these will not withstand the rigours of a possible English winter. They may live through a mild winter such as that of 1877-8, but it would be a great mistake to introduce delicate and tender trees which merely—live without flourishing in our climate. to plant such—however beautiful they may be, or whatever interest may attach to them economically or scientifically—would be a waste of money, time, and labour; would, in fact, be courting failure and disappointment.*

But there is another very important point to work out in the process of planting—variety. The colours of the trees now existing in the forest are, for the most part, a uniform green; and, however correct it may be to use such as the ground-work of our operations, it is desirable to secure every shade of colour, from grass-green and silvery-gray to inky black, as well as the varied tints of the unfolding leaves in spring and the glow of the autumnal foliage in autumn—"those bright leaves whose decay, red, yellow, or ethereally pale, rival the pride of summer." By this means the forest would present an entirely different aspect at each season of the year—spring, summer, autumn, and winter, and no mean end would be accomplished if, in planting, the pleasing natural characteristics of each season could be brought out in all the fulness of their individuality and beauty. It is desirable that we should have here more variety in the young leaves in spring; greater exuberance of foliage, securing coolness and shade in summer; a richer glow of red, yellow, and russet-brown in autumn; and the shelter and furnished appearance of evergreens in winter. For instance, masses of the corstorphine plane (*Acer pseudo-platanus luteum*), the young leaves of which are of a bright golden yellow, might be planted for effect in spring; the Douglas Fir (*Abies douglasii*) for breadth of light and shade in summer, and shelter in winter; the scarlet oak (*Quercus coccinea*) and Norway maple (*Acer plantanoides*), the leaves of the former changing to scarlet, and those of the latter to yellow—to vary and enrich the scenery with their bright and warm autumnal dress. The introduction of trees remarkable for the colours of their leaves in spring and autumn brings out a new feature, which may be said to stand midway between the permanent and incidental beauties of forest scenery. It differs from the permanent, inasmuch as the colours are striking for a short period only, and the leaves fall in winter; it differs from the incidental, because, unlike clouds, storms, mists, sunshine, and shadow, it recurs regularly at fixed intervals. Now, I would not ignore the fact that, in introducing trees with strongly-coloured leaves—as is also the case with flowering trees—there is a danger of producing, by strong contrast, what landscape gardeners call "spottiness." But this is not a necessary consequence of their use; variety is not incompatible with harmony; and their union may be secured under the direction of any one possessing taste and judgment. It may be further remarked that, in attending to the colours of the leaves at various seasons, we by no means exhaust the resources at our disposal to break the monotony which undoubtedly exists at present in many parts of Epping Forest. With the exception of a few hollies, most of the trees and shrubs there are what we call "deciduous;" that is, they lose their leaves on the approach of winter. Dreary indeed, is the aspect of the forest at that season, and clearly open to improvement by planting any of the evergreen firs. Then for further variety, the differing outlines of trees offer abundance of choice; there are the upright and weeping, the spiry-topped and laminate, the exact and diversified. And even the varying forms of leaves afford still further opportunities, if it be thought desirable, as it may be in some few instances—to work out any nicely-elaborated pictures of tree scenery. It is unfortunate that nearly all the trees in Epping Forest have small leaves, with outlines but slightly diversified.

Under the head of planting it would seem well to consider that the picnic or gipsy party is a favourite outing with the English people, and ample provision should be made for the customary spread in a forest devoted to their recreation and enjoyment. This I would propose to accomplish by planting a series of groves, in suitable spots, keeping the stems of the trees clear of branches eight feet or more from the ground, thus combining opportunity for freedom of movement with perfect shade. Whateley tells us "a grove is a place wherein to tarry with secure delight, or saunter with perpetual amusement."

> "Thou dark grove,
> That hast been called the seat of melancholy,
> Sure thou art wronged; thou seem'st to me a place
> Of solace and content, a paradise,
> That givest more than ever court could do
> Or richest palace."

Beech groves and oak groves might be formed from trees already existing, and there might be added chestnut groves, birch groves, lime groves, cypress groves, cedar groves, Wellingtonia groves, and others, almost without limit. These trees should be planted in masses, and in such manner that they also vary and improve the character of the forest scenery.

7. *Trees.*—I shall now offer a brief list of trees and shrubs which stand foremost, in my opinion, as likely to contribute most to the improvement of the existing landscape:—

1. Deciduous Trees, remarkable for the Beauty of their Unfolding Leaves in Spring.

Purple Beech (*Fagus sylvatica*), foliage purple.
Purple Birch (*Betula alba*), foliage purple.
Purple Horse Chestnut (*Æsculus hippocastanum*), foliage purple.
Corstorphine Plane (*Acer pseudo-platanus luteum*), leaves yellow.
Colchicum Maple (*Acer colchicum rubrum*), leaves red.
Larch (*Larix europæa*) leaves light fresh green.
Pyrus Aria (in varieties), leaves white.

2. Deciduous Trees, for Summer Leaves.

Birch (*Betula alba*).
Plane (*Platanus occidentalis*).

* As I have had a nursery at Loughton, in Epping Forest, for the last sixteen years, I speak advisedly on this point. Certain trees and shrubs, which I remember being killed in the winter of 1837-38, and again in 1860-61 in the valley of the Lea, were subsequently planted in these nurseries, and flourished till the last winter, when many were injured, and some destroyed. An additional reason why trees of questionable hardiness should not be used is that there are plenty of hardy trees suitable for all the purposes of Epping Forest.

Poplar, of various sorts (*Populus*).
Lime (*Tilia europæa*).
Horse Chestnut (*Æsculus hippocastanum*).
Spanish Chestnut (*Castanea vesca*).
Gleditschia triacanthos.
Mountain Ash (*Pyrus aucuparia*).
Turkey Oak (*Quercus cerris*).
Magnolia, of various sorts.
Deciduous Cypress (*Taxodium distichum*).
Acacia (*Robinia pseudo-acacia*).
Ailanthus glandulosus.
Sycamore (*Acer pseudo-platanus*).

3. Deciduous Trees, remarkable for the Beauty of the Decaying Leaves in Autumn.

Scarlet Oak (*Quercus coccinea*).
Liquidambar (*Liquidambar styraciflua*), leaves red, purple, and yellow.
Norway Maple (*Acer platanoides*), leaves yellow.
Scarlet Maple (*Acer rubrum*), leaves red.
Tulip Tree (*Liriodendron tulipiferum*), leaves yellow.
Parrotia persica, finely-coloured leaves.
Stag's-horn Sumach (*Rhus typhina*), leaves red and yellow.
Black Walnut (*Juglans nigra*), leaves yellow.
Kolreuteria paniculata, leaves yellow.
Ginko Tree (*Salisburia adiantifolia*), leaves yellow.

4. Evergreen Trees, for Shelter and Effect in Winter:—

Araucaria imbricata.
Deodar (*Abies deodara*), on hills or slopes.
Mount Atlas Cedar (*Cedrus atlantica*).
Cedar of Lebanon (*Cedrus Libani*).
Douglas Fir (*Abies Douglasii*).
Spruce Fir (*Abies excelsa*).
Austrian Pine (*Pinus austriaca*).
Corsican Pine (*Pinus laricio*).
Pyrenean Pine (*Pinus pyrenaica*).
Scotch Pine (*Pinus sylvestris*).
Lawson Cypress (*Cupressus Lawsoniana*).
Lambert Cypress (*Cupressus Lambertiana*).
Wellingtonia gigantea.
Arbutus (*Arbutus Unedo*).
Evergreen Oak (*Quercus ilex*).
Holly (*Ilex aquifolium*).
Black Spruce (*Abies nigra*).
Piceas (various).
Hemlock Spruce (*Abies canadensis*).
Pinus insignis (less hardy than others, but desirable for its colour; should be planted on hills and slopes).
Pinus excelsa.
Sequoia sempervirens.
Cryptomeria Japonica.
Thujopsis borealis.
Thuja Lobbii.
Chinese Juniper (*Juniperus sinensis*).
Red Cedar (*Juniperus virginiana*).

5. Flowering Trees.

Crab (*Pyrus malus*), and its varieties.
Cherry (*Cerasus*), of various sorts.
Hawthorn (*Crataegus oxyacantha*), and its varieties.
Double Sloe (*Prunus spinosa*), flowers purple.
Almond (*Amygdalus communis*).
Plum (*Prunus*), of various kinds.

It may be said that this is a rather limited list of trees, and I admit that it is so. But, then, it must be remembered that we are looking at the question from the forest scenery rather than from the scientific or gardenesque point of view, and for the realisation of our object, we prefer to plant a few really effective trees on a large scale to the introduction of a multiplicity of non-effective species and varieties.

8. *Shrubs and Plants.*—Of shrubs of moderate and lowly growth, the Rhododendron (*R. ponticum*) should specially abound. There are many spots in which it would thrive as well as in its native *habitats*, and the richness of its foliage in winter, and the gorgeousness of its blossoms in May and June, commend it to every observer. Scenes of grandeur and beauty might be wrought out with this shrub, in conjunction with existing trees—that would strike every beholder, and appear and re-appear with their cheering influence in the future amid the busy scenes of the office and of the workshop. The *Azalea pontica* is also a fine-flowering shrub; *Garrya elliptica*, too, which is evergreen, producing catkins like the hazel in winter, the *Leycesteria formosa*, and the *Mahonia aquifolium* are all desirable shrubs. The hazel (*Corylus avellana*) is also desirable on account of the catkins and nuts it produces, and the scarlet and golden willows (*Salix*), and the red-barked dogwood (*Cornus*), for the colours of their bark in winter. The furze (*Ulex Europæus*) should be sown largely in dry, stony places; the splendour of its golden blossoms in early summer is well known, and its rich strong scent is generally agreeable. The broom (*Spartium scoparium*) is also a beautiful plant. However desirable it may be to preserve the species of British plants growing at present in the forest, it is probable that some will be unintentionally diminished in number or, perhaps, destroyed by the work of draining and other improvements. It might, however, be possible to have stations at which the rarer kinds—as the sun-dews (*Droseras*)—could be preserved, and the natural flora might be largely increased by sowing seeds of others broadcast over large tracts of prepared ground in spring. Primroses and blue-bells exist already in great abundance, and there are, perhaps, no prettier wild flowers than these in spring; but there are many others of rare interest which are absent, or are met with only occasionally. Such might be introduced, or increased in number, at a small cost, and, under this head, odoriferous flowers should be largely cultivated. Thus, the unavoidable diminution on the one hand might be compensated for by an increase on the other, and no wild flowers, however insignificant in appearance, should be heedlessly destroyed. I would here put in a special word in favour of the bramble (*Rubus fruticosus*); this should be encouraged on all sides, for this plant is beautiful when in flower, and attractive when in fruit. The Pampas grass (*Gynerium argenteum*) should prove a suitable and effective plant, and wild roses, wild honeysuckles, wild clematis, the hop, ivy, Virginian creeper, St. John's wort, lily of the valley, periwinkles, and violets, should specially abound. Heath and fern are already plentiful, and both are valuable—the former for its beautiful flowers, the latter for its leaves and autumn tint.

9. *Animals and Birds.*—We have hitherto been dealing with inanimate Nature, the still scenes of pastoral beauty. But we must not stop here. We want the variety and excitement of life and motion. In addition to the cattle, which will presumably continue to pasture here, deer and other harmless animals (*ferœ naturæ*) should abound in a

forest of this size, and should be increased, or even imported, while noxious reptiles, like the adder, should, if possible, be extirpated. I am tempted to put in a word in favour of the squirrel, although, having in view foresters and keepers, I do so with fear and trembling. But there is certainly recreation and enjoyment in watching the gambols of a company of squirrels, and no one would begrudge them the nuts and acorns on which they principally feed. Unfortunately, however, they have the reputation of feeding on bird's eggs, and even killing young birds. And, again, they have the mischievous habit of biting the growing shoots off trees, which, by arresting growth, causes the tree to assume a stunted and miserable appearance. Nevertheless, I think, on summing up the *pros.* and *cons.*, they should not be altogether excluded. Birds, again, should be encouraged, by strictly preserving those that are indigenous to the forest, and bringing others from various parts of England, keeping up a stock of the plants on which they feed, by planting or sowing fresh seeds in spring. It will hardly be questioned that a herd of deer crossing one's path in a forest ramble is a pleasant *rencontre*, while the flitting and song of birds is a constant source of interest and delight.

(*B.*) *Recreation Grounds* (enclosed).—It may seem an anomaly to speak of enclosed recreation grounds in an unenclosed forest, but I presume that special recreation grounds must exist, and, if so, that they must be enclosed for the convenience and comfort of the public. Whether the fences be of iron or in true forestal rustic character seems to matter but little, although I rather incline to the latter. They may be sunk or hidden by plantations. There should be open spaces for cricket and other English games. There should also be water of uniform and safe depth here for bathing, boating, fishing, and skating. In these grounds, there would be a fair opportuuity, should it be deemed expedient, for more elaborate ornamentation, by the introduction of various trees and shrubs which might not be in correct taste in the open forest as I have foreshadowed it, or which could not safely be trusted there. But I would not go further in this direction than the planting of trees and shrubs; I do not want a flower garden even here; the ornamentation, if more elaborate, should be but slightly so. Although I have offered the opinion that the open forest should not be converted into an arboretum, or a series of arboretums, I yet think that an arboretum in the enclosed grounds would be a source of recreation and enjoyment to the public. It has, too, a *raison d'être* on scientific and utilitarian grounds. If somewhat formal within, the exterior might be so planted as to blend harmoniously with the natural scenery of the outside forest.

(*C.*) *Lodges.*—It would be too much to expect that every entrance to the forest should be adorned with a lodge, or lodges; but some, at least, of the entrances would seem to be proper and convenient places for them. A forest of between five and six thousand acres will, of necessity, require a staff of men—call them keepers, or what you will—to perform the multifarious duties attendant on its preservation, and to maintain order. For comfort and economy, their dwellings should be near their work; and this would, in many cases, require them to be in the forest. These lodges and their surroundings should, I think, vary in design, that the one may not be mistaken for the other, but the whole might be of one style of architecture, and I should give the preference to the Gothic. In their construction, ostentation or parade should be scrupulously avoided.

In conclusion, permit me to remark that, while dwelling on this subject, I have been deeply impressed with the fact that never before in the history of England has such an opportunity been afforded of making a grand national recreation ground. Ostensibly for the use of the inhabitants of London, it may become in the future, and that without any vast expenditure of money, "a thing of beauty," which shall be a joy to every Englishman, and one of the bright spots of our island which shall be sought out by visitors from the most distant shores.

DISCUSSION.

Sir T. Fowell Buxton said those who were interested in Epping Forest had every reason to be thankful, both to Mr. Paul and to the Society of Arts, for this opportunity of bringing the question before a London public. It would be gratifying to the members of the Epping Forest Committee to feel that, when they had settled with the lawyers, there would still remain a little occupation for them, and something on which to spend the ample resources of the City of London. One or two points he should like to say a word upon. In the first place, he was very anxious that whatever was done in the forest, should in no way destroy its wild character, and the sensation it left on the mind that it was a real bit of nature. Mr. Paul defined deciduous trees as those which shed their leaves on the approach of winter, and said Epping Forest was full of deciduous trees. Now, he was in Epping Forest on the previous day, and never saw in an English forest or an American one a more beautiful effect of autumnal scenery, than was disclosed by the rays of the declining sun on the hornbeams in the Theydon and Loughton manors. The leaves had not fallen, and that was one of their most beautiful features; the trees, partly because they were pollarded, and partly because they were nibbled by cattle, retained their leaves until the young ones came and pushed them off. There were not merely reddish brown leaves, but these were interspersed with hollies, which gave brilliancy and light to the scene. The question of the introduction of foreign trees had been brought forward in a most interesting paper by Mr. Wallace, which no doubt they had all read, but he feared, on reading it, that it might lead to an error which had been made in many public parks and lawns during the last 30 or 40 years; the whole world had been ransacked for new plants, flowers, and trees, until some lawns and parks were more like a museum of specimens—a beautiful object, no doubt, here and there, but without the charm of a great mass of one kind. Mr. Paul had guarded himself against wishing to bring about that state of things, but it was a fault which they must endeavour to avoid; and he could not help thinking that if foreign trees were introduced, it would, in some measure, take off the effect of real wildness—of a forest which had been so for all time, as far as history went. Whilst he felt that, however, with regard to the wild part of the forest, it would not prevent the idea being acted upon in other places. There was a broad slope in Loughton-manor, which sloped down to Woodford and the Loughton road,

and there were other broad expanses, which had been cleared of every vestige of forest vegetation, and would require some attention to make them ornamental, and worthy the renown of Epping Forest. Here there would be a good opportunity for planting such trees as Mr. Paul referred to, or those from the temperate zone, such as Mr. Wallace had called attention to. Everything of the kind would require some enclosure, which would go rather against the grain with visitors; but that feeling would not arise so much in the case of portions which had been already enclosed. As to the introduction of water, the greater part of Epping Forest was on the London clay, and no series of strata so readily lent themselves to the making of sheets of water. He held that in old times the county of Essex was much better supplied with water than at present. There were places in the parish of Waltham, and elsewhere, where you could see the remains of embankments, which at one time must have stopped back sheets of water, but as land became more valuable, they had been broken through. The lower part of the forest would lend itself readily to this; it had not escaped the attention of the committee, and the more it was looked into the more it would be found how easily it could be accomplished. With regard to the drainage, no doubt there were places where it would be an advantage; but there were many marshy places full of charm, from the vegetation which belonged to them. You might feel a little annoyed at seeing your best horse floundering in a bog; but these bogs were not very deep or very broad; and some, at any rate, should be preserved for the sake of young botanists. The effort should be, above everything, to retain the wild character of the place; so that people, as they walked or rode through it, might feel that they were looking at a piece of land in the state in which it had been for many centuries. And there were even charms in those features which had arisen from art. He could not agree with Mr. Paul's sweeping denunciation of the pollards. There was an extreme quaintness and beauty in some of those gnarled old stems, five or six rising from one root and uniting in one mass at the top, which recalled the spirit of old German fairy stories, and he thought they should almost all remain. But the main thing was not to interfere with the natural wildness of the forest.

Mr. C. Cooke said he knew Epping Forest well, and was very glad it had been preserved for the public. He was also glad to see that a club had been formed to preserve the plants, trees, birds, and deer, which would have a good effect. He hoped the squirrels would be preserved, and did not believe they were mischievous. Danger from fire would also have to be guarded against, and he hoped it was not true that Temple-bar was to be re-erected there.

Mr. Frederick Young said he came there that evening with some degree of anxiety, fearing that Mr. Paul, in his views as to the future of Epping Forest, might differ from many of those who had taken a deep interest in this question, and who had known the forest all their lives, as he had. But he had been much pleased with the paper, and thought they were much indebted to Mr. Paul for his suggestions. He was glad to hear Sir Fowell Buxton's opinion as to the matter of dealing with the forest, and agreed with him that the forest itself should be left as much like what it had been hitherto as possible. They should endeavour to preserve the main features of the grand old forest, and not turn it into a large park or system of gardens. They wanted it for the recreation and instruction of the vast population of London, and that could be best attained by interfering as little as possible with it. To all these points connected with drainage, making the necessary roads, and developing the trees that existed at present, he thought the attention of the Conservators would be most usefully directed; but he hoped they would not go much beyond that. He recollected in February, 1872, there was a large meeting, when the future of the forest was very uncertain, and he congratulated every one present on the triumphant success which had at length been attained, for which their thanks were mainly due to the Corporation of London.

Mr. Frederick Cox said one advantage which had arisen from the litigation that had taken place with regard to Epping Forest, was the public attention it drew to the subject. The Corporation had as yet only got possession of a portion of it, but it would be satisfactory to Mr. Paul to know that up to the present time they had not acted in any way antagonistic to the views which he had propounded. Various things had been suggested—one, that it should be made an ornamental park of very beautiful character; another, that it should be preserved in its entirety as a forest; and if he knew anything of the intentions of those who had the care of it, their general idea was in accordance with that now put forward. Though they might make some parts more ornamental, on the whole it should be kept for the recreation of the public, and for that they must rely on its grandeur as a forest. The making of reasonable paths, and a few avenues, would no doubt be required, and this had already been commenced; but when the forest came entirely into the hands of the Conservators he had little doubt that they would act in the spirit of Mr. Paul's remarks, and he begged to thank him for his admirable suggestions.

Mr. Tracy said a great part of this land was in no sense a virgin forest; it had been enclosed and cultivated. There was a large portion which required draining, or it would only be swampy and unhealthy in summer, and he thought if the land were still let for grazing it would bring in sufficient revenue to pay the expenses of keeping in order and planting fresh trees to replace the older ones. He desired to thank the Corporation for the excellent service they had done in fighting the rapacious lords of manors who had laid their hands upon the forest.

Mr. C. J. Glass ventured to put in a claim for a section of the community which had not hitherto been mentioned, viz., the children, especially of the east of London. He looked upon Epping Forest as a grand place for the recreation of these children, and he hoped the governors would bear that in mind. Those who had anything to do with large schools in the east of London knew what a difficulty there was in finding places where they could take the children, where they could be free from that dangerous animal, the London rough. He was glad to hear the suggestions that enclosures for recreation should be provided; and he hoped the children would not be forgotten, and that they would have as much liberty as possible; that the keepers would not prevent them bringing home armfuls of buttercups, and now and then a little branch of May, which they placed in water, and which gave them an immense deal of pleasure. But while they gave full liberty to the children, he hoped they would put a very strong hand on the London rough, or else the beautiful picture they had in their minds would never be realised. It made his blood boil sometimes to see these loafing vagabonds, with their cages and bird-lime, catching little birds at the very time when they were breeding, and unless a strong hand were put upon them it would be useless to encourage birds in the forest. Another matter of omission was the architectural features of the forest. Some facilities should be provided for picnics, without detracting from the beauties of the forest, or running danger of fire. Those who rode or drove might go to the far end of the forest, and see all its beauties, but the neglected parts nearer home, such as Wanstead-flats, might also be much improved, and rendered serviceable for such purposes as he had mentioned.

Mr. A. R. Wallace thought the main object to be arrived at should be, in a few words, to preserve and produce by any possible means, for future generations of Englishmen, the greatest possible amount of beauty and the finest effects of forest scenery capable of being produced in our country and climate. He had lived in forests probably more than most Englishmen, and there was nothing he enjoyed more. The peculiar charms which attached to forests were—first, their wildness, their solitude, and grandeur; next, the varied combination of sylvan beauty produced by the vegetation; next, the exceeding beauty of large grand specimens of trees individually; next, the variety and beauty of the animal and vegetable life which you found in forests and nowhere else; for, wherever you went all over the world, if you wanted to find the most interesting and beautiful plants, animals, birds, and insects, you must go into the forests. Then there was another point in which forests were so delightful to the inhabitants of cities or cultivated ground, which was the feeling of relief, of liberty, you enjoyed there. With regard to these special beauties and advantages to be gained by the preservation or production of fine forests in our country, it appeared to him that the first thing was to preserve this wildness, and for that purpose everything approaching to symmetry, whether in curves or straight lines, should be sedulously avoided, and it required great care to avoid it. Then, again, solitude could only be produced by great extent, and, therefore, his idea was that it should be the first principle to cover the whole ground, speaking, generally, with forest scenery. Of course, they would not interfere with the beautiful open grassy glades which were the chief charm of forest scenery, because without them you could not see the forest. He quite agreed, therefore, with Mr. Paul, that in the matter of roads and paths great caution should be used; none should be made without good reason, and large open roads should be few; paths might be more numerous, but if there were too many, and, above all, if they were symmetrical, the wild character of the forest would be destroyed. Grandeur was chiefly produced by an abundance of large noble trees, and of that he was afraid there was no much chance in Epping Forest for the present generation; but it could be produced by carefully selecting suitable species, choosing and preparing the ground, and seeing the trees did not kill each other by being allowed to grow thickly, which was the common fault of planters in this country. A varied combination of sylvan beauty was to be obtained in the manner Mr. Paul had laid down, by planting a sufficient variety of trees—he did not care whether they were British or foreign, so that there was sufficient variety—but, at the same time, not too great a variety, in one spot, but arranged in masses, groups, and groves. To encourage plants, animals, and birds, nothing was wanted but to leave them alone; you only wanted time and the absence of destroying agencies. For that purpose, extensive tracts should be left in their natural state as far as possible. Sir Fowell Buxton had admirably shown how much draining was required for comfort, but large tracts of marshy land should not be destroyed, as it would only add to the monotony which already existed. There was another important thing—perhaps the most important and the most difficult, as the forest was near a great city, and was for the use of a great population—it was necessary to make it accessible and enjoyable. Now at present a great portion of the surface had been ruined, by actually carrying away the soil, leaving great holes into which you were constantly stumbling without great care. Now, the enjoyableness of a forest depended in great measure on the freedom with which you could walk about in it; you did not want to look at every step, but to walk on a tolerably regular surface carpeted with the natural vegetation. This had been to a great extent destroyed, and one of the greatest difficulties the Conservators would have to deal with would be to restore that surface. Again, that point about liberty was more important, and that was entirely in the power of the Conservators. They should not interfere any more than was absolutely necessary with the perfect freedom of everyone who went into the forest. His idea was, that no man, woman, or child, should be prevented cutting any stick they liked, which they could cut with a pocket-knife. They all knew what a delight it was to a boy to cut a stick, and, as for picking flowers, what was the use of having them if children could not go and gather them? The forest was so large, that hardly any restriction of that kind was needed; but chopping and lopping must of course be forbidden. Mr. Paul had admirably laid down the chief lines on which improvement should be made, and to go into details was out of the question. Sir Fowell Buxton had slightly misrepresented his paper, because in that he most carefully guarded himself, and restricted his proposal to the planting of foreign trees on those tracts of ground which had been enclosed and cultivated, and where he himself thought they would be suitable.

Sir T. Fowell Buxton thanked Mr. Wallace for his correction, and was glad to find that they were as one on this point.

Dr. Murie said he had feared that Mr. Paul, from his horticultural proclivities, would have been inclined to turn the forest into a great park, but was glad to find, both from him and other members, that the general opinion was in favour of leaving the forest to nature. The whole discussion seemed to have gone on generalities; but he wished to point out that work had been already commenced in a line contrary to Mr. Paul's views, for a broad straight road had been made from Loughton to the top of the hill. He should also like to know from the Chairman if the system of lopping was to continue.

The Chairman said it would be stopped on April 25th next.

Dr. Murie, after again referring to the road, also objected to some of the drainage works which had been commenced. They had heard from Mr. Wallace what the great beauty of a forest consisted in, and this would be destroyed by too much drainage. A little surface drainage was all that was required. It was necessary to have certain secluded spots to which the animals and birds could retire and be unmolested, and the best protection to such places would be a bog; it would protect the animals from the most destructive animal of all, the London rough. If the Committee wished to see a natural forest close to a capital, let them go to Stockholm, where they would find within a few hundred yards of the town a virgin forest, where everybody could enjoy themselves. If they could transplant that forest here, by all means do so, but if not, they should try to imitate it.

Mr. Dipnall thought it would be a good many years before Mr. Paul's ideas could be carried out, but still, it was only right to plant trees for future generations. Those who knew the old Spanish chestnuts in Greenwich-park, were perhaps not aware that they were planted in the reign of Charles II., and they were much indebted to Evelyn and others who in those days paid attention to forestry, and the growth and preservation of trees, not merely for naval purposes, but also for the sake of beauty. He thanked Mr. Paul for his suggestions, and the Corporation for what they had done; but he thought some gentlemen rather overshot the mark, if they wished it to be understood that all the 50,000 people who went to the forest on a Bank Holiday were to bring back an armful of walking-sticks, for they would soon have to say *bon jour* to the trees if that were so. He should rather prefer to see the rule adopted in cemeteries and other places followed, and all picking of flowers and cutting of trees forbidden. There should not only be carriage drives, but walks, which would enable the foot passenger to get over the ground easily, and Mr. Paul's remarks about roads and

avenues had his entire sympathy. Those who had been to Versailles would know that there was a great deal to be got out of forest avenues. With regard to solitude, he did not want all the New Forest to himself, and the idea of solitude was quite opposed to that of 50,000 people going there on a Bank Holiday.

The Chairman said he could assure Mr. Paul that every word he had said would be thoughtfully considered by the Epping Forest Committee, because they knew he was a man speaking with authority. Some of the things he had suggested were already in course of being carried out. They were now making a beautiful grass ride, 10 miles in length, for the benefit of riders, and also of those who walked, and they were also stopping the lopping. It cost a great deal of money to do that, for every man who had had a house for 20 years in the parish was entitled to compensation. They courted criticism, for they had but one object. They had gained this magnificent forest after a hard battle, at an expense of something like a quarter of a million, for the enjoyment of the people, and of the people of the present day in the first instance. They intended to leave Epping Forest alone as much as possible, an actual forest. They must drain the land in certain places where it required it, but that must be done very tenderly. They should plant, as a matter of course, and they must make it more accessible, because in some places it was not accessible; but further than that, they did not think of doing much work to the forest itself. In his opinion it was perfection. He thought to take a person from one of the squalid courts or monotonous streets in the east of London, and put him down with his wife and family in Epping Forest, and tell him he might go where he liked, and do what he liked, provided he did no mischief, was amply sufficient. People came to him, poor men and women with tears in their eyes, and said, is it true we can go anywhere we please about here? He said, "Yes, and do what you like, provided you do no mischief." That was their reward. They wanted to leave the forest proper almost as it was, a thing of beauty and a joy for ever. But there were large portions which had been thrown into cultivation, and they were to be thrown out of cultivation and restored to the forest. There was plenty of opportunity there for any gentleman who had an eye for the picturesque, or large views with regard to futurity, to show his skill and energy in planting. He could do no mischief there, and he might do much good. But with regard to the forest itself, he did not believe it could be greatly improved. He did not agree with some who said there were few fine trees in Epping Forest. He saw plenty in some portions. What could be better than roaming about High Beech amongst those grand old trees? Many had been lopped and lopped, but they had recovered themselves, the same as the grand old Burnham beeches had. He concluded by moving a hearty vote of thanks to Mr. Paul.

The vote having been carried unanimously,

Mr. Paul said he had paid attention to all which had been said, but there was nothing to which he need reply. He did not suppose that he had said all that was to be said, and if he were writing the paper again, many things he had heard he should certainly introduce.

MISCELLANEOUS.

LONDON WATER SUPPLY.

Colonel Bolton's report to the Local Government Board on the water supplied by the Metropolitan Water Companies for December, 1879, contains the following particulars respecting the supply of hydrants:—The number of miles of streets which contain mains constantly charged, and upon which hydrants for fire purposes could at once be fixed, in each district of the metropolis is as follows:—Kent Company, 85 miles; New River, 201; East London, 85; Southwark and Vauxhall, 112½; West Middlesex, 70; Grand Junction, 41½; Lambeth, 70; Chelsea, 56; making a total length of 721 miles. The water companies are ready to affix hydrants thereon when required by the authorities. The total number of hydrants erected is at present 5,348, of which 2,982 are for private purposes, 555 for street watering, 1,336 for public use, and 475 in Government establishments.

WATER SUPPLY OF TOWNS.

A return has been made to the House of Commons, on the motion of the Marquis of Stafford, by the Local Government Board, showing the means by which drinkable water is supplied, either by public or private arrangements, to every urban sanitary district in England and Wales. Answers were received from 944 sanitary districts, and the particulars mostly relate to the latter half of 1878. In several instances the authorities were at that time entering, or about to enter, upon undertakings for the improvement of their water supply. The information contained in the return is arranged under 12 heads:—1. Name and population of the place according to the census of 1871; 2. Source from which the water is supplied; 3. Arrangements made for the supply by reservoir, wells (artesian or otherwise), rivers (if filtered or not), or any other arrangements; 4. Amount of daily supply, and whether or not the supply is sufficient; 5. Whether the supply is constant or not, and the quantity used daily; 6. The rateable value of the district; 7. The capital cost of the permanent works, if any; 8. The annual payment for principal and interest on money borrowed for the works; 9. The average annual cost of maintaining the works; 10. The annual amount of the water-rates and rents, if any; 11. The Act of Parliament or other authority under which the works have been executed; 12. What improvements, if any, are considered necessary. The metropolis, not being entitled an urban sanitary district, is not included in the return.

COST OF ILL-HEALTH.

The following remarks are taken from a paper lately read by Dr. John Watts (a member of the Society of Arts) before the Manchester and Salford Sanitary Association:—

"With respect to the extent to which personal and social suffering was accompanied by pecuniary loss, it looked a small matter that a man should miss a few days' work occasionally because he was not quite well; but when we learned that in the Manchester Unity of Oddfellows alone there was paid in 1878 for sickness the sum of £347,213, or 13s. 4d. per member, and that that large society only represented about 10 per cent. of the heads of families in England and Wales, it was no longer to be called an insignificant affair. The heads of families in England and Wales numbered about 5,111,111, of whom 4,259,259 were working-class families, whose weekly wages would amount to about £5,322,675, or £887,112 per working day. The experience of friendly societies showed an average of sickness varying from 1·94 to 2·45 weeks per annum per member between 21 and 70 years of age. But we had to include, in our calculation, the less prudent men who were not members of friendly societies, and we might safely assume an average sickness of 2½ working weeks per annum, and then we should find that by loss of work through sickness the

working men lost no less than £13,306,687 per annum. If we added to that sum 25 per cent. for the losses of employers and dealers, we should find a loss to society, the measure of which was £16,632,359, or £1,108,824 for each day of sickness.

"Here, then, was our additional motive for work as sanitary reformers; for every day that we could lessen the average sickness of the heads of families of England and Wales we should add to the wealth of the country by more than a million sterling. The heads of families in Manchester and Salford numbered about 111,111, the working-class families being 92,593, whose weekly wages amounted to about £115,741. The average sickness of two and a-half weeks would in this case, therefore, cost £289,352, or £19,292 per day. For every day that such sickness could be prevented by public sanitary measures the authorities of Manchester and Salford would add to the wages of working men £19,292. With 25 per cent. added for profits of employers and dealers, the gain to society would be £24,115 for every day so saved. And if the sickness of the workers were lessened by public improvements in and about their homes, and by the isolation of cases of infectious diseases, the health of the non-workers would also be improved, and money would be saved if not earned. He urged the importance of those who were principally to gain by the results of sanitary reform being got to take an interest in its progress, and spoke of the advantages of provident dispensaries."

APPLIED SCIENCE EXHIBITION, PARIS.

(Continued from p. 165.)

Sanitary Appliances.

M. A. Dumuis, Paris, demonstrated, by the aid of glass models, the efficacy of Mr. Banner's ventilating cowl, and also showed several sizes of his own manufacture, many applications of which he has already made in Paris. Jewell's system of ventilating a house was shown by an elaborate model.

Messrs. J. L. Bacon and Co., London, showed in action their method of warming buildings by coils of small wrought-iron pipes, and also drawings of a drying and disinfecting closet on the same system, in which a temperature of 500° Fahr. may be obtained.

The Compagnie Générale de Filtrage, Paris, had on view a large assortment of their filters, which consist of a cast-iron case, made in the form of an inverted truncated cone, in order that, when the filtering substances become charged with impurities, they may, by preventing the flow of water, give warning of the necessity for renewal. The substances employed for filtering are—sponge, crushed sandstone, wool, animal charcoal, and sand or gravel, the order of which is slightly varied for different waters.

It is forbidden in Paris to discharge night-soil into the sewers; it is, as a rule, received into cesspools. But the cost of emptying these has led to a new system being adopted, especially where w.c.'s are used. The soil is received in *tinettes*, or cylindrical receptacles, with a perforated diaphragm, which allows the liquid to run off into the sewers (under special license), while the solid matters remain behind in the *tinettes*, which are replaced periodically. Still the cost of emptying is heavy; and a company has been formed in Paris for doing this work gratuitously for the sake of the manure, provided the houses be fitted, at a fixed scale of charges, with their arrangement of *tinettes*. In this arrangement, the liquid is intercepted by two separate enlargements of the soil pipe, and allowed to flow into the sewers without having to filter through the soil in the *tinette*. Closets on this system were fitted up in the Exhibition for the convenience of visitors; and those interested could make themselves acquainted with the working. M. Gérault showed his simple syphon w.c., to be flushed with water, which has no mechanism but the conical valve for admitting the water, with chain and bell-crank.

The St. Luc inodorous disinfectant is stated, in an analysis made at the laboratory of the Museum of Natural History, Paris, to have the power of absorbing and fixing 266½ litres (9½ cubic feet) of ammoniacal gas, or 136½ litres (5 cubic feet) of hydro-sulphate of ammonia. It is used by the Paris municipality, and in the leading hospitals. M. A. Schlumberger showed several applications of salicylic acid, which has been called "the most rational of antiseptics." In hospitals it is recommended as a disinfectant, especially when combined with 25 parts each of alcohol and glycerine, and 50 of water. Fumigations made by vaporising a small quantity on a red-hot shovel have the advantage of giving no disagreeable odour. This substance has also been applied with great success to the preservation of all kinds of food; and M. Schlumberger has some specimens of vegetables prepared in May, 1876, for the Brussels Exhibition, which, though their receptacle was opened twenty times a-day during that period for showing to visitors, are still in a perfect state of preservation. Some Normandy butter, mixed with a thousandth part of salicylic acid, has been sent out to Brazil and back, when it was found to have retained its flavour and freshness. M. J. A. Pennès, Paris, exhibited a case of uncooked fish, meat, &c., preserved by his antiseptic, which consists of salicylic acid associated with alumina, benzoin, and a preparation of the Eucalyptus. This substance is admirably suited to the preparation of anatomical and zoological specimens, because it has the property of hardening without altering the tissues.

Appliances Connected with the Nursery.

The diploma of honour in the *Classe de l'Enfance* was awarded to the Société des Crêches, who exhibited an elaborate model, showing the interior economy of their establishments. A model was also sent of the English Orphanage at Neuilly, in the foundation of which Messrs. Galignani were chiefly instrumental.

Views accompanied by a description were shown of the Ferme d'Arcy, about 30 miles from Paris, on the Eastern line, where over a hundred cows are kept for supplying the metropolis with milk absolutely pure, and from the same cow if required. The morning's milk is cooled in a refrigerator, and kept at a temperature of 4° Cent. (39° Fahr.) until eight p.m., when it is mixed with the evening's milk, and put into small white, earthenware jars, with air-tight covers, sealed with lead, containing the supply ordered by each customer. These leave at ten o'clock, and arrive in Paris at midnight, when they are kept in refrigerators until delivery at five o'clock the following morning. The milk of the Domaine de Courquetaine, in Seine-et-Marne, is somewhat similarly treated, but is packed in jars of tinned iron, with locked air-tight covers. Dr. Liebaut exhibited his *hochet*, or child's coral and bells, having, on the end inserted in the mouth, a hollow and perforated india-rubber capsule for enclosing pastilles, compounded with various medicaments, sugar and gum.

There were two appliances for supporting children while learning to walk. One, by Mr. Lavergne, Paris, consists of a padded hoop, to be fastened round the waist, supported on four splayed-out legs, capable of being lengthend or shortened, and running on castors. The other, shown by M. J. Mégissier, Place Dumesnil, Paris, consists of a table on wheels to which the child is strapped, but having a seat brought up automatically directly he stoops to sit, and removed on his again standing up. Some perambulators were shown, the frame and wheels of which pack into the body, forming a parcel that can be carried under the arm. On the opening day, the late M. Jules Favre gave the name of *cheval hygiènique* to a new rocking horse, devised by Mr. Meinhard, engineer, London, which affords more exercise and a nearer imitation of the action of riding than its predecessors. The "horse" is articulated by

two uprights, about six inches apart, to the fixed stand, while strong spiral steel springs, at the front and back, are alternately compressed and drawn out by the weight of the child's body, thrown alternately forward and backward.

DOMESTIC.

A piece of "cork-leather," made by Messrs. De Beerski and Co., London and Paris, was laid down in front of their stand, in the nave, where it was walked upon by the thousands who visited the Exhibition during the four months it remained open; and yet, though not fixed down as usual, and subject to the sand and gravel with which the nave was laid being carried on to it by the feet, it showed no sign of wear at the close. It consists of cork, in a finely divided state, attached by india-rubber solution to a flax cloth, and, owing to its non-conductibility, forms a very comfortable carpet. The "cork-cloth," consisting of a thin sheet of cork between two tissues, has been much improved since the Maritime Exhibition in 1875, and is used in the English and French navies, and the English army, for waterproof garments, sheets, tents, &c., being impenetrable by fresh or salt water and the sun's rays, and not attacked by insects, while it is also very light and supple. M. Bourguignon, Donchéry, Ardennes, makes from the feathers of poultry, which would otherwise be wasted, a felt which is lighter and warmer than woollen fabric. It is of different thicknesses and various colours, so that it can be made up into garments for both men and women. M. Martin showed some muslin curtains rendered fireproof, to which a flame was constantly applied with the effect of charring them only. M. Nemitz, of Paris, exhibited clocks and watches provided with dials which appear luminous in the dark, so that the hour can always be ascertained.

M. J. Sprunk, Paris, showed some improved meat-mincing machines, for hand or power, in which two horizontal shafts, armed with curved knives, revolve in contrary directions, the knives just clearing one another, while the concave basin turns on a vertical axis. Wladislas Kleczkowski, of Vilna, offered to visitors his concentrated *bouillon*, which he recommends in preference to extract of meat, because containing all the component parts of ordinary *bouillon*, including the fibrine and albumen. M. Bessède, *hors concours* as a member of the jury, showed his preparations from the Eucalyptus, for superseding injurious liqueurs, such as *absinthe*.

MISCELLANEOUS.

A diploma of honour was awarded to the Count de Beaufort, on behalf of the Société de l'Assistance aux Mutilés Pauvres, for the mechanical limbs exhibited; A carpenter working at his trade, and a girl knitting, both supplied with artificial arms, were to be seen daily at the Exhibition. A similar honour was accorded to Dr. Gustave Zander, of Stockholm, for his mechanical appliances for medical gymnastics, whereby the frames and muscles of weak and sickly persons are strengthened, and various ailments and deformities treated. M. Paz, Paris, showed a full-sized gymnasium with the latest improvements, and also working models of chamber gymnastic appliances for curing defects. Messrs. J. R. Whitley and Co., London and Paris, showed the "Gwynfé" patent hammock-tent, which affords a portable weather-proof shelter and sleeping place, quite independent of ropes, trees, or pegs, and folding up into very small compass. M. J. Léard contributed his appliance for permitting a man to exist while surrounded by deleterious gases. A mask, tightly fitting the head, is put in communication with a pure air-supply by a flexible tube, thus permitting the wearer to breathe both through the mouth and nose.

M. Richard, Paris, an army clothier, finding that the use of the sewing machine exercised an injurious effect on the health of his workwomen, and estimating that the cost of any known motor would swallow up too large a proportion of the small profits of his business, devised an appliance, in which an ordinary French poodle, held in a cage outside the centre of gravity, by stepping continually on the outside of a drum, developes sufficient power to drive four sewing machines. In this *moteur-quadrupède*, which is applicable to all vertebrate animals, the dead weight is turned to full account, scarcely any muscular force is exerted, and there is no liability to accident or discomfort. M. Engström showed a bit and bridle for controlling unmanageable horses by means of an interrupted galvanic current, and also a manger, on the same principle, for curing horses of crib-biting. M. Babonneau showed a new bit, used by the Cie Générale d'Omnibus, for more effectually controlling horses, without bearing on the lower jaw, or giving them pain. The bit itself is a tube, merely serving as a fulcrum for the two levers on each side, which, on being pulled by the reins, draw the muserole on to the nose, thus giving complete command over the animal, while his taking the bit between the teeth would not prevent its action.

Signor Danielli, who coated by electro-metallurgy the plaster cast in the 1878 Exhibition of the equestrian statue of the Prince of Wales at Bombay, exhibited some wonderful reproductions of ancient statues, &c., made of hardened plaster of Paris, coated by electro-deposit. M. David, Paris, showed specimens of his universal stencil-plate, or sheet of thin metal perforated with fine elongated holes, arranged in such a pattern that all letters of the alphabet, with stops and accents, the Greek capitals, and a great variety of ornamental borders, can be traced out by it. Two modifications of the electric pen were shown; one, worked by a galvanic battery, and another driven by compressed air acting on valves, which, by gear, communicate the reciprocating motion to the needle. M. Ruentz showed a simple little instrument for describing ellipses with the aid of an ordinary set-square. M. Delagarde manufactured, in the presence of visitors, his paper binders, which consist of two strips of metal, curved transversely, so as to approach each other, hinged together and kept closed by two clasps.

TRADE IN ALIMENTARY PRESERVES AT NANTES.

The productions from the City of Nantes, says Consul Clipperton, have a universal reputation, and consists chiefly of sardines, tunny fish, lobsters, green peas, asparagus, choucroute, meats, and game. The manufacture of preserved vegetables, meats, and game, is performed in the establishments at Nantes and the suburbs, and that of the fish in the branch establishments on the coast of Brittany and Vendée. The yearly average of the quantity manufactured is estimated as:—Sardines in boxes, 4,000,000 kilos; tunny fish, 250,000; lobsters, 4,000; mackerel, 20,000; green peas, 1,600,000; asparagus, 25,000; and foie gras and truffled game, 400,000 boxes. The plantation of German cabbage for making choucroute has succeeded very satisfactorily in this district. About 170 acres of land were planted with this cabbage, which produced upwards of 500,000 heads, equal to 750,000 kilos of choucroute. It is only within the last two years that this manufacture has been undertaken, and apparently it will be most successful, and compete seriously with the productions from Alsatia, which are now subject to duty in being imported to France. Independently of what is sold in France, large quantities are exported to England, America, and the French colonies. A very important contingent of this trade is the manufacture of tin boxes, which gives continual employment to numerous establishments. On an average 12,000,000 boxes are annually turned out of different patterns for fish and vegetables. Some makers work solely for certain houses, others sell what they make to the best purchaser. Tin plates

from England and other parts are used in this trade. The boxes for exportation to Spain and Algeria for sardines, and to Singapore, Cayenne, and Martinique for preserved pine-apples, are sold either finished or cut and prepared for soldering, so as to save the expenses of carriage. About 4,000,000 boxes are exported annually. During the winter the boxes are made for the following fishing season, when the workmen go to the different manufactories on the coast in order to close the boxes filled. The wages paid are good, especially when the fishing is productive.

THE CRYSTALLISATION OF CARBON.

The following note on this subject appears in the *Chemical News*, signed with Mr. Crooke's initials:—

"Since sending the telegram* announcing that carbon crystals, apparently diamond, could, without difficulty, be produced from any carbon compound, Mr. Mactear has sent me several specimens of his supposed artificial diamond. He has also called upon me with other specimens, and has explained the whole process by which he obtains such remarkable results. As, however, he has sent to the Royal Society a paper, which will probably be read in the course of a week or two, I am not yet at liberty to give details of the process.

"The general character of the specimens now in my possession may be described as irregularly shaped masses from 1 m.m. downwards in diameter, with rounded angles, and showing no definite crystalline appearance. They are whitish looking, translucent, and, as a rule, lustreless; many pieces are almost spherical, and appear like fragments of corundum which have been water-worn. Amongst these are perfectly clear fragments larger in size, some being 3 or 4 m.m. across, having a conchoidal fracture exactly like glass.

"In a paper 'On Molecular Physics in High Vacua,' read before the Royal Society in March last, and now being published in the 'Philosophical Transactions,' I referred to the remarkable power possessed by the molecular rays in a high vacuum of causing phosphorescence in bodies on which they fall, and I remarked that the only body which surpassed Becquerel's luminous sulphides, both in brilliancy and variety of colour, is the diamond. Most of these gems, whether cut or in the rough, when coming from the South African fields, phosphoresce of a brilliant light blue colour. Diamonds from Brazil shine with different colours, such as bright blue, pale blue, apricot, red, yellowish green, orange, and light green. A beautiful collection of diamond crystals, kindly lent me by Professor Maskelyne, phosphoresced with nearly all the colours of the rainbow, the different faces glowing with different shades of colour. On receiving the specimens from Mr. Mactear, I immediately submitted them to the molecular discharge. The following are the results I have at present obtained:—

"In a high vacuum, the specimens phosphoresce brightly of different colours—pale blue, orange, apricot, and yellowish green. The clear, glassy fragments are also phosphorescent. The appearance of the phosphorescence is very similar to that shown by small rough diamonds from Brazil, called, in the trade, 'Boart;' indeed, had I not known the history of the fragments in my tube, I should, from their appearance, have said that they were small fragments of Brazilian Boart.

"The opaque, rounded appearance of the fragments is unlike that of the natural diamond, but, by heating a rough diamond before the blowpipe until it has partly burnt away, it assumes a very similar appearance to that of Mr Mactear's crystals, and it is, therefore, not unlikely, from their mode of preparation, that these crystals have undergone partial combustion after their formation—a fact which would explain this difference in appearance. Other specimens having been placed by Mr. Mactear in competent hands, with a view of determining their hardness and chemical properties, I have refrained from making experiments in this direction."

* *Chemical News* vol. xi., p. 306 (Dec. 26th, 1879).

NOTES ON BOOKS.

Gilds: their Origin, Constitution, Objects, and later History. By Cornelius Walford, F.I.A. London (printed for private circulation): 1879.

The author first treats of the origin and diversified objects of these very ancient associations, and then proceeds to review the external history of the Frith-Gilds, Religious Gilds, Social Gilds, Merchant Gilds, Burg-Gilds, and Craft Gilds, adding some notes on the more prominent points in the administration of their internal affairs. The progress of Gilds in Great Britain is then traced chronologically through the Roman, Anglo-Saxon, and Norman periods, up to the present time, and special attention is given to those founded in some of the chief cities, as London, York, Bristol, Cambridge, Birmingham, Coventry, &c. The author concludes his essay in the following words:—"We have traced not only the origin of Gilds, but their transformation and decline . . . The proportion which have died out, as against those which have gone through the process of transformation, is a point very difficult to determine of the Gilds of the City of London, which we have seen took, at a very early period, municipal form, the facts are as follows: 76 still survive, 73 of which continue to take fees for admissions to freedom; 36 have halls of their own—although many were destroyed by the fire in 1666; 53 are trustees for the administration of bequests; 20 have almshouses for decayed members and their widows; and 14 have established and maintain schools in various parts of the metropolis, or in the country. Many are again paying attention to the advancement of the crafts with which they were originally associated; and technical education in this respect bids fair to be of real value, and may lead to the preservation of industries which would otherwise, in the industrial competition of nations, pass away in other directions. But apart from the revival of the early Gilds, there has been during the past quarter of a century or more a tendency to the establishment of new ones."

Primer of the Industrial Geography of Great Britain and Ireland. By G. Phillips Bevan, F.G.S. London: W. Swan Sonnenschien, and Allen.

This is the first of a series of text-books, in which it is intended to explain, in simple language, the resources and industries of each country, together with the physical and geographical causes that have led to their existence. The several chapters into which the volume is divided treat of metals, hardware trades, building, glass, and pottery, textile trades, agriculture, food, and drink, railways and shipping ports.

GENERAL NOTES.

Architectural Museum.—Mr. J. P. Seddon has commenced a source of six lectures on the history of architecture, entitled "Caskets of Jewels," at the Royal Architectural Museum, Tufton-street, Westminster. The first lecture was delivered on the 27th inst., and the succeeding ones will be given on the last Tuesday evening in each month.

Kew Observatory.—The report of the Kew Committee for the year ending October 31, 1879, has been published by the Royal Society. It contains a statement of the work done in the two departments of magnetism and meteorology, and a notice of certain of the instruments. It appears that 196 barometers, and 4,828 thermometers have been verified during the year. Besides these last, 53 deep sea thermometers have been tested, the greater number of which were subjected in the hydraulic press without injury, to strains exceeding three and a half tons on the square inch.

Telephones in America.—An interesting trial was made with Bell telephones, December 26th, between Dayton, Ohio, and Indianapolis, Indiana, a distance of 108 miles. The wires of the American Union Telegraph Company were used, and the experiment proved conclusively the utility of Bell telephones for distances within 100 miles. Conversation between the exchange offices of the two cities was maintained throughout the day. A circle of 100 miles radius, with New York as a centre, includes all the western part of Connecticut as far as New Haven, with its numerous large and growing towns and cities; the Hudson River cities as far as Hudson, taking in Poughkeepsie, Newburg, Sing Sing, and other large cities; all the cities and towns of New Jersey; Wilmington in Delaware; and Philadelphia, Reading, Easton, Scranton, and other large places in Pennsylvania. A slight addition to the radius, still without much exceeding the distance between Dayton and Indianapolis, includes Hartford on the north-east, and Baltimore on the south-west. All these great centres of population and trade are thus already within possible telephonic reach of New York.

Teachers' Training Syndicate.—Mr. J. G. Fitch, M.A., H.M.'s Inspector of Schools, will deliver a course of fifteen lectures, on the "Art and Practice of Teaching," before the Teachers' Training Syndicate, Cambridge University, in the Lent term, 1880, with the object of directing attention to the general character and conditions of successful teaching, and of investigating in detail the best methods of training and instruction in connection with each of the ordinary subjects in the curriculum of secondary and higher schools. The first lecture will be on "Method," the second, third, and fourth lectures on "The School and Discipline," the fifth, sixth, and seventh on "Memory, Examination, and the Training of the Eye, Ear, Hand, and Voice," and the 8th to the 14th on subjects of study, such as Language, Mathematics, Geography, Physics, and History, the whole course concluding with a discussion of other resources available for a teacher's purposes, and other aims to be kept in view; *e.g.*, the culture of the imagination and the taste; the regulation of conduct; the shaping for each pupil of an ideal and plan of life. General recapitulation. How to co-ordinate the various subjects of study, and to give true unity of purpose to a school course.

Application of Physics to the Arts.—By permission of the Lords of the Committee of Council on Education, the following courses of lectures will be given, illustrating some of the applications of physics to the arts:—1. Captain W. De W. Abney, F.R.S., will give a course of six lectures, on "Radiant Energy and its relation to Photography," on the following days:—23rd, 24th, 25th, 26th, and 27th of February, and 1st March, 1880 (at 8 p.m.). Fee £1. 2. W. G. Adams, M.A., F.R.S., Professor of Physics, King's College, London, will give a course of six lectures, on "Electrical Measurement, in relation to Telegraphy," on the following days:—5th, 8th, 9th, 10th, 11th, and 12th March (at 8 p.m.). Fee £1. 3. F. G. Barff, M.A., late Professor of Chemistry at the Royal Academy, will give a course of six lectures, on "Colour and Pigments in relation to Painting," on the following days:—15th, 16th, 17th, 18th, 19th, and 22nd March (at 8 p.m.). Fee £1. 4. Dr. W. Stone, M.A., will give a course of six lectures, on "Sound in relation to Music and Musical Instruments," on the following days:—1st, 2nd, 5th, 6th, 7th, and 8th April (at 8 p.m.). Fee £1. All the above courses are open to women. The courses will only be held if not less than thirty applications for cards of admission are made in each case, not less than a fortnight before the beginning of the corresponding course. Cards of admission and detailed prospectuses for each of the courses will be obtainable at the publication stall in the South Kensington Museum three weeks before the beginning of the corresponding course. In all the courses a reduction of one half of the fees will be made in favour of those engaged in teaching. All the courses will be given in the Physical Lecture Theatre, Science Schools, South Kensington, S.W. (Entrance in Exhibition-road.)

Preparation of Rhea Fibre.—The Government of India in 1870, and again in 1877, offered rewards for the discovery of a cheap and rapid mechanical or chemical process for the preparation of rhea fibre, which is at present worth from £40 to £50 per ton in England. Fifty thousand rupees for the best invention, and 10,000 rupees for the next best. A keen competition promises to take place shortly at Saharanpur between twenty-three gentlemen from England, America, France, Denmark, New Zealand, Batavia, Hungary, and from parts of India. The judges of the trials will, says the *Homeward Mail*, have to describe the processes and determine whether the conditions of the Government notification have been complied with or not, while the quality of the fibre produced will be left to experts at home.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 4.—"Trade and Commerce with Siberia, *viâ* the Kara Sea." By HENRY SEEBOHM. CLEMENTS R. MARKHAM, C.B., F.R.S., will preside.

FEBRUARY 11.—"A New Metallic Compound and its Application to Industrial and Artistic Purposes." By GRANVILLE COLE, Ph.D. GEORGE GODWIN, F.R.S., will preside.

FEBRUARY 18.—"The Euphrates Valley Railway." By W. P. ANDREW.

FEBRUARY 25.—"The Noxious Gases Bill." By E. K. MUSPRATT, F.C.S.

MARCH 3.—"The History of Musical Pitch." By ALEXANDER J. ELLIS, F.R.S.

MARCH 10.—"Recent Advances in the Production of Lambeth Art Pottery." By JOHN SPARKES.

MARCH 17.—"The Art of the Silversmith." By W. HERBERT SINGER.

APRIL 7.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A.

APRIL 14.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday Evenings, at eight o'clock:—

FEBRUARY 12.—"Gas Furnaces and Kilns for Burning Pottery." By HERBERT CUTHRIE, C.E.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

JANUARY 30.—"Herat." By Colonel G. B. Malleson, C.S.I. ADMIRAL SELWYN will preside.

FEBRUARY 20.—

MARCH 5.—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"The Present Condition and Prospects of Agriculture in South India." By W. ROBERTSON, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 3.—"Social and Commercial Prospects in the Transvaal." By the Rev. G. BLENCOWE (late of the Transvaal and Natal). W. C. SERGEAUNT, C.M.G., will preside.

FEBRUARY 24.—"Views of Colonization." By WILLIAM FORSTER, of New South Wales. Sir CHARLES NICHOLSON, Bart., will preside.

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S., will be delivered on February 2, 9, 17, 23; March 1, 8.

LECTURE I.—FEBRUARY 2.

Sources of India-rubber. Chemical and physical properties. Behaviour with chemical reagents. Action of various solvents. Effects of heat, cold, aud light.

LECTURE II.—FEBRUARY 9.

Mechanical and chemical purification. Working of unvulcanised caoutchouc. Formation of blocks, sheets, and threads. Elastic webbing. Other uses of unvulcanised India-rubber.

LECTURE III.—FEBRUARY 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

Every member is entitled to introduce one visitor to each Lecture.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 2ND...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture I.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. Finlay Dun, "American Production of Wheat and Meat."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Inaugural Address by the President, Mr. Joseph Bernays, and Presentation of Premiums for Papers read during the Year.
Royal United Service Inst., Whitehall-yard, S.W., 8½ p.m. Mr. B. Tower, "Tower's Revolution Indicator."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Mr. Hormuzd Rassam, "Late Assyrian and Babylonian Research."
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Armstrong, "The History of Chlorine."
Social Science Association, and Society for Promoting the Amendment of the Law, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. Stephen S. Alford, "The Habitual Drunkard's Act of 1879; the Class of Persons for whom it is intended, and how it may be Administered; with an Account of a Recent Visit to the American Inebriate Homes."
TUESDAY, FEB. 3RD...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Rev. G. Blencowe (late of the Transvaal and Natal), "Social and Commercial Prospects in the Transvaal."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. A. Schäfer, "Physiology of Muscle." (Lecture IV.)
Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m. Discussion of one or more of the following subjects:—"Local Rating," "Railway Freights," "The Malt Tax," and "A Minister of Agriculture."
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion upon "Fixed and Movable Weirs," and, time permitting, Mr. J. J. Webster, "Iron and Steel at Low Temperatures."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
WEDNESDAY, FEB. 4TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Henry Seebohm, "Trade and Commerce with Siberia, *via* the Kara Sea."
Geological, Burlington-house, W., 8 p.m. 1. Professor John W. Judd, "The Oligocene Strata of the Hampshire Basin." 2. Mr. George Robert Vine, "A Review of the Family Diastoporidæ, for the purpose of Classification." 3. Mr. W. H. Twelvetrees, "A New Theriodont Reptile from the Upper Permian Cupriferous Sandstones of Kargalinsk, near Orenburg, in South-Eastern Russia."
Entomological, 11, Chandos-street, W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Mr. H. Collier, "Tincture of Senega as an Emulsifying Agent." 2. Professor Redwood, "The Diffusive Properties of some Preparations of Iron, in Relation to Dialysed Iron."
Archæological Association, 32, Sackville-street, W., 8 p.m. Mr. John Brent, "Dozmare Pool, Cornwall."
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
THURSDAY, FEB. 5TH....Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. C. B. Clarke, "Remarks on the Order Commelynaceæ." 2. Mr. H. M. Brewer, "The Salmonidæ and other Fish introduced into New Zealand Water."
Chemical, Burlington-house, W., 8 p.m. 1. Mr. R. W. Atkinson, "Contributions from the Laboratory of the University of Tokio, Japan, on Persulphocyanate of Silver." 2. Mr. H. F. Morley, "Methylated Dioxethylenamines."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. H. H. Statham, "Elements of Architectural Designs."
South London Photographic (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.
Royal Institution, Albermarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture II.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. H. Ellis Hill, "Corn Mills."
Archæological Institution, 16, New Burlington-street, W., 4 p.m.
FRIDAY, FEB. 6TH....Royal United Service Institution, Whitehall-yard, S.W., 3 p.m Colonel C. B. P. Nugent, "Aspects of Home Defence."
Royal Institution, Albermarle-street, W., 8 p.m. Weekly meeting. 9 p.m. Dr. Huggins, "Photographic Spectra of Stars."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. 1. Mr. T. B. Sprague, "Some Differences between the Speech of Edinburgh and London." 2. Mr. Benj. Dawson, "The Middle Voice in Virgil's 'Æneid,' Book VI." 3. Mr. Hy. Nicol, "English Etymologies, Correcting some of Prof. Skeat's, Part III."
SATURDAY, FEB. 7TH...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Ernst Pauer, "Handel, with Musical Illustrations."

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FRIDAY, FEBRUARY 6, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

BERLIN EXHIBITION OF EARTHENWARE.

The following correspondence on an Exhibition of Earthenware, Cement, Gypsum, &c., to be held at Berlin, in June of the present year, has been forwarded to the Council of the Society by the Secretary of the Committee of Council on Education:—

Science and Art Department,
30th January, 1880.

SIR,—I am directed by the Lords of the Committee of Council on Education to transmit to you the accompanying papers, which have been forwarded to this office by the Board of Trade, relating to an International Exhibition of Earthenware proposed to be held at Berlin this year.

I am to request you to be good enough to submit these papers to the Council of the Society of Arts, who may possibly consider it desirable to cause them to be issued, for the information of such manufacturers of ceramic wares as may be personally interested in taking part in an Exhibition, which would appear to be directly connected with this important branch of manufacture.

I am, Sir, your obedient servant,
NORMAN MACLEOD.

H. T. Wood, Esq.,
Society of Arts, John-street, Adelphi, W.C.

[TRANSLATION.]

Berlin, November 15th, 1879.

I hereby inform the Board of Trade, London, that an Exhibition of Earthenware, Cement, Gypsum, &c., will be held at Berlin from June 29th to August 10th, 1880, of which the enclosed papers will give the necessary information.

It is most desirable for the promotion of the International Exhibition, that foreign countries should take a prominent part in it, and, therefore, I ask you kindly to give us all the influence in your power, to further this branch of industry.

The appointed Commission would be much obliged if the Board of Trade would announce the Exhibition, and kindly inform the respective firms, and ask them to take part in the forthcoming Exhibition.

If the Board of Trade should wish to distribute prizes at the close of the Exhibition, the Commissioners would be much obliged for information on this point.

Your obedient servant,
(Signed) S. PAUL LOEFF.

To the Board of Trade, London.

[TRANSLATION.]

International Exhibition of Earthenware, Chalk, Cement, and Gypsum Industry at Berlin, 1880, *from June* 29*th to August* 10*th. Rules for sending objects to the Exhibition.*

1. Only such objects can be sent to the Exhibition as are directly or indirectly made of brick, tiles, earthenware, chalk, cement, or gypsum.

2. The committee has to decide about the named objects, and of the amount of space granted to the exhibitors.

3. Application must be made before the 15th March, 1880, but it is most desirable to have the applications as early as possible, so that the space may be fixed, especially as there is the prospect of nearly all nations taking part in the Exhibition.

4. The forms of application are to be made in duplicate by each of the exhibitors, and to be sent to the president of the committee—Herrn Paul Loeff, Privat Baumeister, Berlin, S.W.

5. Should the object be admitted, a certificate of admittance will be made out on the information paper, which at the same time contains a declaration of the Exhibition. One of the application papers will be returned as a receipt. Only those exhibitors who possess a receipted form, can be admitted to exhibit different objects.

6. All the admitted objects must be at their proper places (appointed by the committee) three days before the opening of the Exhibition, in perfect order and dry colours. The committee reserves the right of deciding about the unoccupied space, without being obliged to return the money. Other places than those given by the committee, are not allowed to be used.

7. The committee will give a number to each object, before it is placed in the Exhibition Building, which will correspond with the number in the Exhibition Catalogue. This number must be fixed to each object, so that it can be seen for the whole time the Exhibition is open.

8. All exhibitors, their agents, or their workmen, must submit themselves to the committee, or to the officials of the Exhibition.

9. The committee does not undertake any responsibility in case of damage or loss of those objects, which are brought to the Exhibition, but they will take the greatest care in watching the objects. Fire or light can only be used by specially written allowance from the committee.

10. The committee will undertake to arrange for the Fire Insurance if desired, but the expenses fall upon the exhibitors.

11. The price for space occupied is fifteen marks per square mètre; unoccupied space will be eight marks the square mètre. The minimum price for occupied space will be twenty marks, and for unoccupied space twelve marks, per square mètre.

12. The exhibitors must clear their objects immediately after the Exhibition is closed, but no object can be removed before the final closing.

13. An Exhibition Agency, which will be put under the control of the committee, will carry out all commissions given by exhibitors for a small payment. The exhibitors have to take upon themselves the transport of the Exhibition objects, as well as unpacking, arranging, and repacking. The committee has made arrangements to have the work done by their agents at a small expense, in order that the exhibitors may be saved from overcharge, as has been the case at former Exhibitions. If desired by exhibitors, artisans and workmen can be provided for by the committee at the lowest rate.

14. No exhibitor is allowed to put an engine into motion before he has obtained special permission from the committee. This permission will be given on the

fulfilment of the rules. The supply of the necessary material is to be arranged in each case with the committee.

15. If special architectural plans are desired, they have to be named under No. 9 in the forms of announcement; if necessary, designs should be added. At the wish of the exhibitors, the committee will undertake the erection of such engines as are required.

16. Those exhibitors who want special foundations must have them erected by the committee, and pay the necessary expenses.

17. Prizes will be given in each section, but a juror cannot be an exhibitor in his own section. The names of the jury will be published in the middle of July.

18. The Exhibition Catalogue will contain advertisements, and each exhibitor can make use of the allotted space by paying 75 pfennings (or 9½d.) for a *petit* line.

19. The committee reserves the right of altering these rules, and retains the power of refusing such applications as are thought unsuitable.

20. Demand will be made for the return by the railway authorities, gratis, of all objects which are not sold, the result of which will be published in due time.

The President of the Committee,
Paul Loeff.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Friday, January 30th, 1880; Admiral Selwyn in the chair.

The paper read was—

HERAT.

By Colonel G. B. Malleson, C.S.I.

The position of Herat invests the city and the province of that name with a peculiar importance. All the conquerors of India, the English alone excepted, have penetrated into that country from the north, and all those conquerors, excepting one, have entered by the gate of Herat. The exception was the founder of the Moghol dynasty—the Emperor Babar. But, although Babar did not possess Herat when he made the invasion which was the prelude to the conquest of India, he did possess the gate second only to Herat in importance—the gate of Kandahar. It is a fact well worthy to be studied, that the three invasions of India attempted by Babar prior to the fourth and successful invasion were baffled solely because he had not, at the time, a secure hold of Kandahar. The fourth succeeded only after Babar had, in the interval, taken the strongest measures to make his hold on that city certain. At this period Khorasan, the province of which Herat is the capital, was the battlefield of the Persians and the Uzbeks. Neither of these rivals had any thought of India. Babar then contented himself with securing the lesser gate. He conquered India. Herat fell into the hands of Persia. The folly of securing only the lesser gate of Kandahar was shown a hundred years later, when Persia, having still the greater gate, conquered also the lesser. From that time the way to India was always open. But the other great conquerors—Alexander the Great, Mahmud, Chingiz Khan, Taimur, Nadir Shah, and Ahmad Shah—all took care to secure Herat before they invaded India. Alexander proved that, that gate secured, the line of the Indus was no real defence for India; Mahmud, of Ghazni, proved that the frontier held by Jaipal and Anandpal—a frontier very similar to that occupied by the British up to the end of 1877, for it embraced the Pashawar valley, and stretched up to the entrance to the Khaibar—was not defensible. The armies of Chingiz Khan forced the barrier of the Indus and ravaged the Panjab. Taimur encountered little resistance in his invasion of India. Neither Nadir Shah nor Ahmad Shah met with any serious obstacle between the frontier of the Panjab and the Satlaj. Their difficulties began after crossing that river.

It is this fact which invests Herat, at the present moment, with such extraordinary interest—the fact that the greatest conquerors whom the world has ever seen on Asiatic ground were careful to secure the gate she represented before they penetrated beyond it; that the one conqueror of India who neglected this precaution bequeathed to his children's children an heirloom of weakness, which ended in the virtual overthrow of his dynasty. The Moghol monarchy never recovered the two invasions of Nadir Shah and Ahmad Shah.

Herat was for many years—she may be styled still—the capital of eastern Khorasan. Situated in the fertile valley of the Herirud, the city has been famous for the purity of its air, the salubrity of its climate, the abundance and excellence of its water supply. From time immemorial the proverb has been current, "Khorasan is the oyster of the world, and Herat is its pearl." To the question asked in its early days, "Which is the most glorious city in Asia?" the streotyped reply has been "If you speak the truth, you must say Herat." It is this city, and the surroundings of this city, I propose to describe this evening, accompanying the description with a brief outline of their early history. I shall then proceed to indicate the position which the city occupies with respect to Sarrakhs, to Merv, and to the Oxus, towards the north; to Persia towards the west; and to Kandahar towards the south. I shall conclude by demonstrating the physical causes which make Herat, in very deed, the gate of India.

The Herirud, or river of Heri, rises in the mountains of Hazarah, on the western declivity of the Koh-i-Baba. Its source is described by Conolly as "a pool of gently bubbling springs, where the boiling point showed an elevation of 9,500 feet." Up to its junction, near the village of Chiraghdan with a lower branch, known as the Sir Tingalab, the main branch bears the name of Jangalab, but from this point the united streams are called the Herirud. From the sources above indicated the river takes a course of about three hundred and fifty miles almost due westward, to a point three miles south of Herat. Thence it continues its course, at first westerly, but bearing gradually to the north-west for more than fifty miles. It then turns, almost suddenly, due north, runs in that direction for about two hundred miles, assumes, after passing Sarrakhs, the name of Tajand, and under that

name is lost in the sands and swamps of the great Turkman desert.

The valley which this river waters is the most fertile valley in Central Asia. Narrow at Chiraghdan, it opens out at the village of Obeh, some 50 miles west of Herat, to a width of 8 or 10, gradually increasing at Marwa to 12, and a few miles further, to 15 miles. To fertilise this valley, the earlier rulers of the country—the princes of the Seljuki and Turki dynasties—ordered the construction of numerous water courses, canals, and reservoirs. The artificial aqueducts so constructed carried the abundant water of the Herirud throughout the length and breadth of the valley, and, acting on a soil naturally rich, caused it to produce, in the richest abundance, the corn and the fruit which form the sustenance of life. There resulted from this fertility a prosperity unsurpassed in Central Asia. The valley of the Herirud came, even in those days, to be termed its garden, and, as a natural consequence, the chief city of the valley came likewise to be known as its granary. The prosperity of the granary and the garden went hand-in-hand; that of the former depending, in a great degree, on the well-being of the latter.

Not, however, absolutely. A glance at the map will show that Herat occupies a central point, on which converge the roads leading to Kabul, to Kashmir, to India on the one side, and to Bokhara, Persia, Arabia, Turkey, and even Europe on the other. The trade of those countries then centred in the city; their richest products were sent to its bazaars to be sold and to be exchanged. It was this great fact which caused the earlier monarchs of Herat to spend the wealth accruing to the city, as the capital of the garden of Central Asia, in the erection of magnificent markets and splendid caravansaries. Those monarchs saw plainly that the interests of Herat lay in fitting her to be, *par excellence*, a city for merchants; a city which, attracting trade by its situation, would keep it by providing the traders with such luxuries and appliances as would endow it with the properties of an unequalled market, and a perfect haven of rest. It was this policy which gave birth to the proverb I have already quoted. "Which is the most glorious city in Asia?" "If you speak the truth, you must say Herat." Such were its beginnings. In the twelfth century its prosperity was already assured. The city could then boast, in addition to its public market, of 12,000 retail shops, 6,000 public baths, caravansaries, and water mills, 350 schools and seminaries, and 144,000 occupied houses.

This commercial prosperity bowed before the ravages inflicted by the armies of Chingiz Khan and Taimur. The buildings and the ornaments of the city suffered indeed enormously for the moment, but the damage to commerce was passing. These conquerors differed in one important respect from the Afghans. Savage as were their natures in some respects, they were yet gifted with the instincts of statesmen. They would sweep on, destroying to satisfy the ruder passions of their soldiers, but they did not remain, to crush out every symbol of life. Taimur, though he treated Herat with great and unnecessary severity, could not shut his eyes to the natural capabilities of the place. So much indeed was he penetrated by the advantages offered by its splendid situation, that, from a distant part of Asia, he sent his son, Miran Shah, to repair the damages his own soldiers had committed. Subsequently, he bestowed Khorasan with two other provinces on his son, Shah Rokh. That prince made Herat his capital. He retained it as his capital when, on the death of Taimur in 1405, he succeeded to his father's dominions.

Then ensued more than forty years of prosperity for Herat—years during which the city was beautified to an extent unknown elsewhere in Central Asia, whilst its commerce made strides not less rapid. The twenty-three years of disputed succession which followed the death of Shah Rokh checked but little the prosperity to which he had given so great an impulse. The reign of Sultan Husen Mirza which then followed and covered thirty-five years, brought the glory of Herat to its culminating point. During his reign Herat was emphatically the queen of Central Asia. In the magnificence of her public buildings, in the splendour of her markets, in the wealth and prosperity of her people she was without a rival. Nor was this all. Under the rule of this able sovereign, Herat became the resort of the most famous philosophers, poets, and divines in Central Asia. The wise policy which attracted these men to the city provided ample fields for the exercise of their acquirements, and thus worked, in the most practical manner, for the civilisation and the contentment of the people.

The gradual decadence of Herat dates from the death of this prince in 1506. A wise and powerful prince can decree almost every eventuality, this alone excepted, that he be succeeded by princes as wise as himself. The sons of Husen Mirza were unwise. The Uzbeks expelled them from Herat, and Khorasan then became the battlefield on which that warlike people contended for supremacy with the Persians. After many changes of fortune, the contest was decided in 1537 by the retreat of the Uzbeks. Khorasan thus fell to Persia.

The rule of the Safvi dynasty inaugurated a new system for Herat. The efforts of the princes of this race were directed to found a new capital in Khorasan to supplant the old one. They selected Mashad for this purpose. For a hundred and eighty years the Persian monarchs exerted all their power and all their influence to divert the trade line from Herat to that place. Their direct efforts failed. Mashad possessed, indeed, the direct trade line with China, but the commerce of the other countries I have referred to would not quit the royal road. In many points, indeed, Herat suffered. She ceased to be a capital—even a seat of Government. The learned of Central Asia, no longer supported, quitted her walls. Her palaces crumbled, her royal gardens became deserted, and the country seats in the Murghab Valley were gradually abandoned. But, as a commercial centre, she still, for 180 years, held her own. Worse days were, however, in store for her.

In 1717, Herat was occupied by the Abdali Afghans. The hold of those barbarians of the mountain upon the commercial city has—the short interval of the supremacy of Nadir Shah excepted

—lasted to the present day. It is there now. For upwards of a century and a half Herat has groaned under the rule of unlettered barbarians, who never improve; of destroyers who, adepts at pulling down, never repair; of ruffians, who rob and murder and plunder now just as they robbed and murdered and plundered a century and a half ago; and of oppressors, who stifle trade and harry traders. These Afghan tyrants never reason. They are too shortsighted to examine the problem of the result on their own wealth of a fair patronage of trade; of the gain that would accrue to themselves by securing for commerce free ingress into and egress from the city which is theirs only by conquest. It has never occurred to them that it was their interest to procure, at least, security for traffic. Far from doing this, they have laid upon the traders a tariff, which is all but prohibitory; they have connived at the plunder of caravans outside the city walls. By their cruel treatment of the artisans they have driven the best of them to Mashad, thus effecting, by their cruelty, a result which more polished Persia had failed to compass. The consequence is that the great market, once the glory of Central Asia, is all but deserted; the caravanseries are in ruins, of many of the palaces scarcely a trace remains, the people are bowed down to the dust, and the beautiful valley is overrun by marauders.

The evil has been gradual. So buoyant were the resources of the city, that it required many years of constant pressure of the heavy hand of the Afghan to keep them down. Mr. Forster, who was at Herat in 1783, describes the city as far surpassing Kandahar in the extent of her markets and the amount of her merchandise. In the caravanseries he met about a hundred bankers and traders from India, all well-to-do men, possessing the highest credit. Nearly thirty years later, Captain Christie was able to give an account which, by comparison with the present, is bright and glowing. As far as his eye could reach he saw orchards, and gardens, and corn-fields. Coming from Sabzwar, he had to ride for two hours between luxuriant fields and gardens before reaching the Herirud, and, crossing that river, two hours further through a similar country ere he could arrive at the city gate. In the market he found wares from India, from Persia, from the shores of the Caspian, from Orenberg, from Samarkand, and from Afghanistan. Herat was still holding her own.

Twenty-one years later, Conolly records a sad falling off. The capabilities of the country, indeed, he describes to be far greater than he had expected; but, he adds, these had been wasted partly by the internal misrule of the Afghans, partly by their inability to prevent the raids of other tribes.

The later writers, Ferrier and Vambéry, note a still further declension. The latter, who visited Herat in 1863, describes the cruelty, the rapacity, the unchecked license of the Afghans, and the misery of the Heratis, in language the strength of which it would be difficult to surpass. He thus sums up his condemnation of them and of their system:—

"It is a pity that, instead of seeking to heal the wounds which they (the Afghans) have inflicted, their miserable policy seems now to aim at reducing the province still further to beggary, so that, in a country where, undoubtedly, they are called upon to play an important part, they have rendered themselves objects of detestation, for the inhabitants would at once again plunge into a hopeless contest rather than ever again acknowledge the supremacy of the Afghans."

It is refreshing to turn from this picture of the results of the misrule of man to survey once again the beautiful valley through the spectacles of an observant and enlightened Englishman. "We ascended," wrote Arthur Conolly, in 1831, "by one hundred and forty steps to the top of the highest minaret—and then looked down upon the city, and rich gardens and vineyards round and beyond it, a scene so varied and beautiful, that I can imagine nothing like it, except perhaps in Italy." As Conolly saw it, that valley had been beheld by Shah Rokh, by Sultan Husen Mirza, by Babar. Amid the destruction of buildings, and the ravages caused by the passions of uncivilised man, nature remained still true to her original purpose. Of the valley of the Herirud she had made her most luxuriant garden; of that garden Herat had become the richest granary. The granary, built by men and destroyed by men, might decay, might even disappear; but the garden was indestructible. For nearly two hundred years it has been proof against the most cruel abuse of power. Under that abuse Arthur Conolly saw it still smiling, still vying even with the glorious landscapes of Italy. It is this ability to flourish in spite of misgovernment that invests the valley of the Herirud with a magic charm—that gives it a value, vast, immeasurable, and self-contained.

I propose, now, to describe the position occupied by Herat, with respect to the most advanced post of the Indian empire towards the south-east, and to the peoples and tribes to the west, the north-west, and the north.

At the present moment, the advanced post of the Indian empire, in the direction of Herat, is Kandahar. Kandahar is, in fact, the frontier post to the north-west of the empire founded by Babar—the frontier post which he left to his successors, and which, for want of the protection which a connection with Herat would have secured for it, was wrenched from those successors by the Persians. I shall endeavour to show, now, the enormous importance of a connection between the two places, as rendering them both practically impregnable!

Herat is about 370 miles from Kandahar. There are, at least, three practicable routes between the two places. That by Girishk, Farrah, and Sabzwar presents no great difficulties. An inner line, turning north-westward, at a more acute angle from Girishk, and thus avoiding to Farrah and Sabzwar, is likewise practicable. Ferrier, however, recommends a third route for an army, as presenting no difficulties whatever regarding water supply. By his plan an advancing army would march to Farrah, thence to the nearest point of the Harut-rud river, and follow the course of that river under its varying denominations, until its junction with the Rud-i-Gaz, not far from Herat.

It matters little which of these lines be taken. They possess alike this great advantage—that, whichever of them were followed by a power possessing alike Kandahar and Herat, would be

found unassailable. The road from Kandahar to Farrah is covered to the north of the Siah Koh and the Ghor mountains; to the south, by a succession of sandy deserts. From Farrah to Herat the mountains still completely cover the right of the advance, whilst the left is equally protected by the salt desert, and the desert called Dasht-i-Naubad. The protection thus afforded on both sides is complete. An enemy, who should attempt to break the line by an incursion across the deserts, whilst Herat and Kandahar were held by one strong hand, could not escape destruction. The attempt to cross those deserts has never been found easy, even when no opposition has been offered to it. Opposition could not but cause it to fail.

There are many instances of Kandahar having been successfully attacked by Persia, whilst Persia held Herat, but not one of a successful attack from the west by a power which did not hold Herat. Even Nadir Shah, when he was wielding all the resources of Persia, Georgia, Armenia, and Khorasan, even Nadir Shah marched against Kandahar by way of Herat and Farrah. He made no attempt to break down the defence of the desert. The line, however, has one weak point, and that point is Farrah. "Whoever holds Farrah," writes Ferrier, "has one foot in Kandahar and the other in Herat, and commands the northern entrance to Sistan." During the period exceeding a century which has elapsed between the times of Nadir Shah and the present, Farrah has suffered sieges from Persians, Tartars, and Afghans, mainly in consequence of its position. It is distant about 190 miles by a track running south of the Dasht-i-Naubad desert from the Persian town of Birjun; and the same track, taking a more northerly turn, is produced as far as Nishapur. But a distance of 240 miles intervenes between Birjun and Nishapur. A northern enemy, then, who should attack the line between Herat and Kandahar at its only assailable point, Farrah, must, in the first place, be in close alliance with Persia. Supposing its forces massed, by the connivance of that power, at or near Nishapur, it must then march those forces, with all their *matériel*, along a track more than 400 miles in length, a track deficient in a great many of the necessities of life, and presenting in some places serious difficulties. Whilst engaged in this march, it would be easy for the power holding Kandahar and Herat to concentrate at Farrah such a force as would have no difficulty in repulsing the jaded and wearied enemy on his arrival. There are, too, rivers to be crossed, notably the Harut-rud, before the invader could reach that town, and on the banks of these he could be met with great advantage.

I need not examine in the same minute manner the country between Birjun and Yezd, and Birjun and Kerman, for though these routes are practicable, they are far less advantageous for an invading enemy even than that from Nishapur. On the general question, then, of the vulnerability of Farrah, I think it will be conceded that if we accept Ferrier's opinion, that the power which possesses Farrah has one foot in Herat and another in Kandahar, we can most certainly retort that the power which has one foot in Herat and the other in Kandahar virtually possesses Farrah, and is able to keep it against any assailant. I may add, too, that no attack on Farrah could be possible, except with the permission of Persia, and that power, by such attack, would invite a very severe counter blow direct from Herat on Mashad, and even on Nishapur.

So much for the connecting link between Herat and the nearest town in its direction of the Indian empire. I now propose to prolong the line to the north, and to indicate, as correctly as I can, the relations between Herat and the several peoples there located.

There are two natural valleys which connect Herat with the west and the north. The Herirud, after flowing beyond a point below Herat for about fifty miles in the direction of Mashad, turns suddenly to the north, and passing Sarrakhs at a distance of about 140 miles from Herat, loses itself in the great desert of Kara Kum. On this line then, Sarrakhs is the point of connection between Herat and the desert, which is the abode of the several tribes of the Turkmans. The other valley is that of the Murghab. This valley is reached from Herat by following the valley of the tributary Kushk, as far as Kala-i-Maur. Continuing the journey along the banks of the Murghab, the traveller finds himself at a distance of a little over 200 miles from Herat, close to the ruined castle of Merv, and amongst the huts which still bear the name of this once famous city. Merv is now a ruin in the desert, but on this line Merv, like Sarrakhs on the other line, is the connecting joint between Herat and the desert, and beyond the desert, with the Oxus.

It is important to study these two positions. Sarrakhs is the frontier town of Persia. It is the gate connecting Persia with Charjui and Bokhara. Through that gate a great power from the north, wishing to attack Persia, must enter, or must retire baffled. Its strategical importance is enormous. Colonel MacGregor, who accompanied the relieving Persian troops in their march to it in 1875, thus speaks of it, "With regard to its strategical importance," he writes, "I think a glance at the map will show that in the complications which must arise ere the Russo-Indian question can be deemed settled, its future is likely to be a stirring one. Placed at the junction of roads from Herat and Mashad by the Herirud and Ab-i-Mashad valleys respectively, and at the entrance to the province of Khorasan from the north, it cannot fail to exercise a very serious influence on the momentous issue of the above question." Nor is its commercial importance less. It is admirably situated for drawing to it all the trade between Turkistan and Khorasan, and possesses enormous advantages in the excellence of its climate, its water, and its soil.

Such is Sarrakhs, an outpost of Persia, on the outer slopes of the great range which separates Khorasan from the desert, the slopes known as the Attak or Skirt, passing the home of the Turkmans, and but seventy miles from the ruined castle of Merv. Behind it, its communications alike with Meshed and Herat are secure. It need fear only an attack from the front; and in the front it is covered, first, by nearly seventy miles of desert; then by Merv; then by the 142 miles of desert which intervenes between Merv and the Oxus (Charjui).

Such, I repeat, is Sarrakhs. What a contrast to her is presented by Merv, the other point of communication between Herat and the desert! Merv

has been an ancient and famous city. She owed her prosperity mainly to her position near the Murghab, and the fertility caused by the waters of that river, conducted by a canal to the plains which surrounded it. But during the anarchy and misrule which prevailed at the beginning of the present century, the dam on the Murghab, which brought the waters into the canal, was broken down, and the lands, deprived of nutriment, became sterile and valueless. Merv felt the consequence. The once magnificent city is now represented by a ruined castle. And, though the dam has been restored, prosperity has not returned. When Captain Abbott visited the place in 1840, Merv consisted of an assemblage of about 100 mud huts, inhabited by Turkmans. So wretched was the aspect of the place, that he recorded in his diary—"I was glad to quit this wretched, though much vaunted, plain, and enter the desert, which is a paradise in comparison."

The question then arises, wherein consists the value of a place of which everyone has heard and hears so much? That value cannot consist in the splendour of the town, for its buildings have crumbled away. It cannot consist in the fertility of the soil, for, according to the testimony of Captain Abbott, the soil has not the strength to bear any but the poorer kinds of grain. It cannot consist in the hundred mud huts occupied by the Turkmans, for those huts possess no intrinsic worth. Wherein then does the value consist, the value which threatens to make of Merv a battlefield? There is but one possible answer. The value of Merv consists in the situation, commanding the two outlets into the most fertile country in the world. The one of these leads by the valleys of the Murghab and the Kushk to Herat; the other across the desert of Merv to Sarrakhs. Sarrakhs is more even, than the key of Persia. It commands the second and easier road, the road by the Herirud valley to Herat. In this way, then, and no in other is Merv valuable. No great power would dream of conquering that ruined town or those hundred mud huts merely for the purpose of re-building the one or of summering in the other. The march on Merv of a great power means that that great power has an ulterior object. It cannot mean to halt at a place in comparison with which the desert is a paradise. The announcement, then, by such a power, of its intention to march on and occupy Merv, would be the announcement of an intention to march and take up a position menacing Persia and Sarrakhs with its right wing, the line of the Murghab and Herat with its left. It is certain—in the fitness of things it is necessary—that such a menace must be followed by prompt action, for it is impossible that an army should rest at Merv.

An important logical deduction results from the above argument. Let Sarrakhs and Herat be made impregnable. The world may then listen with the most complete composure to the proposal of a march by a great northern power on Merv.

So much for the connection of Herat with the immediate north. To the west the communication with Mashad, 224 miles, presents but little difficulty. Crossing the Herirud, near Kohsan, about 60 miles from Herat, the traveller to Mashad then leaves the valley of the Herirud, and proceeds by Kahriz, Muhammadahad, and Farimon, to that place. It might be possible, however, to follow the valley of the Herirud to the junction of that river with the Kashaf-rud—a few miles short of Naozabad—and follow the course of that rivulet to a point just above Mashad. I am not aware whether this road has been tried, or whether it would offer any advantages over the route I have already indicated.

It is, I think, unnecessary to pursue further the relations of Herat with the country, inhabited by a kindred people, immediately to the west of it. The interests of those people are identical with the interests of the Heratis. They ask for a guarantee for good government; for protection for their lives and their properties; for free liberty to export and to import under a moderate tariff. Grant them this request, and they are willing to devote all their energies to the cultivation of the richest and most fertile soil in the world, to the development of industries which made their fathers great, and which will restore prosperity to the country, and happiness to themselves. If, then, I refer to the country immediately to the west of the Herati territory again, it will not be in rivalry, but in friendly connection with Herat. It is still a part of Khorasan, the country of which, Herat, in her most prosperous days, was the capital.

I have spoken of the one danger threatening this province, and the mode of meeting it. Let Sarrakhs and Herat be occupied and rendered impregnable by a first-rate power, and the danger of foreign invasion disappears. I cannot, however, leave this part of the subject without referring to the nomadic tribes of the desert, the hardy Turkman warriors, who, whilst they are the hereditary enemies of the peaceful inhabitants of Khorasan, are still, strange as it may seem, their best allies against a foreign invader.

The nomadic Turkman tribes of that part of the great steppe of Khwarizm, perhaps better known as the Kara Kum desert, immediately north of Khorasan, and separated into three great tribes, or divisions—the Tekke, the Goklan, and the Yamut. Of these the Tekke are the most formidable. It is difficult to estimate their numbers. Fraser, who visited their country nearly sixty years ago, was disposed then to believe that they consisted of at least forty thousand families, and it is probably no exaggeration to affirm that in the interval their numbers have more than doubled. They range over a country extending, on the west, from the bed of a small river, called the Sumbar, one of the feeders of the Attrak (the river of the Turkmans), to the vicinity of Sarrakhs on the east, and they are to be found all over the desert, as far as Khiva. "They are," says Fraser, "a treacherous and faithless race, who never suffer an opportunity of plundering, even though it be their friends, to escape them." There is reason to believe that this opinion, which was obtained from Persian sources, is somewhat overdrawn, and that the Tekkes have within them the elements out of which a great people may be formed. In the olden days they acknowledged a feudal lord in the Khan of Khiva, but they have not transferred their allegiance, such as it was, to his virtual successors, the Russians.

The Goklan Turkmans, a tribe of comparatively small influence, occupy the country to the west of that of the Tekkes. Their submission to Persia

some seventy years ago was almost tantamount to a sentence of extinction.

The Yamuts range over the country between the shores of the Caspian and Khiva. But, at the present moment, not the least important tribe of the Turkmans is the Akhal. The Akhals range over the country immediately to the north of that under the guardianship of their brethren, the Tekkes. In number, they probably nearly equal the latter. They are as brave and as resolute as their brethren, and are said likewise to possess qualities which, under the civilising influence of good Government, would seem to promise well. The head-quarters of their chiefs are at the village of Akhal, but they, too, are lords of the desert.

None of any of these tribes descend so far south as Herat. The Turkmans infest the borders of the two divisions of Khorasan, the country near Meshed and near Sarrakhs. But Herat has her own annoyances of the same character. Through the valleys of the Herirud, the Khusk, and the Murghab, there swarm, under the rule of the Afghan, the Taimuris, the Hazaras, the Firuzkohis, and the Jamshidis, plundering and carrying into captivity whenever an opportunity or a chance may present itself. Vambéry, writing of a period removed by only 17 years from the present time, refers to depredations made by one or other of these clans right up to the gates of Herat. The tribe plundered without the walls whilst the Afghan robbed and murdered within. That which was no extraordinary occurrence in 1863 is, probably, the normal condition of life in 1880. The depredations, whether by the Turkmans, in the western, or by the tribes I have spoken of, in the eastern portion of Khorasan, point alike to the evil which is their cause. That evil is bad government. Weak and inefficient as is the administrative system in Persian Khorasan, it is ten thousand times worse in the western, or Herati division of the province. In that division, the indigenous inhabitants are born, are educated, are trained to believe that the one object of a Government is to rob them, to plunder them, and should it see fit, to murder them. They are taught that to gain money is to risk life and all that makes life worth having, to amass property is to render death inevitable, to be clean and well-clothed is to offer a premium to an assassin, to assume an independent air is a crime worthy also of death. The Afghan tyrant who thus places restrictions upon every kind of liberty within the town never dreams of protecting the citizen from an enemy without. On the contrary, he has been known to bargain with that enemy for the division of any spoil which may be wrung by him from the oppressed traders forming a caravan.

Such are some of the evils to which the fairest portion of this earth is still subjected. I attribute it to ignorance, rather than to indifference, that up to the present time not a single word has been spoken on behalf of the oppressed nationalities of that favoured country. It surely is not with ample knowledge of the subject, with a complete cognisance of the actual position of affairs, that the politician and the orator appeal to the Englishmen who listen to them for sympathy with the persecuting and rapacious Afghan. I would have it known far and wide that it is the Afghan who murders, plunders, and oppresses; the Afghan who places his knee on the neck of the once thriving people of Herat and Khorasan, and pointing his knife at their throats, forces them to disgorge the wages of toil. It is the Afghan who has despoiled cities which he did not build, and harries the land which is not his own by right—the Afghan who crushes industry and strangles commerce; the Afghan, who caught red in the act, struggles for the privilege to continue his trade of plunder and life-taking. I am sure it needs only that the truth should be placed before the people of England to satisfy them that these men are totally undeserving of their sympathy. That sympathy will, I trust, be reserved for the Turko-Persian race which made Khorasan great, which after having cultivated the valley of the Herirud to be a garden, made of Herat a granary, worthy even of that glorious garden; which maintained in ever-increasing splendour that granary and that garden under sovereigns of their own blood, despite of occasional sieges and occasional occupations of the city by an enemy; which manfully combated against the rivalry of Mashad, and which, brought finally under the crushing rule of the Afghan, has still cherished the memory of the past, and has never let go hope for the future. That race, reduced by persecution, by murder, by captivity, is struggling now, vainly perhaps, but manfully, against the savage mountaineers who have ground them down for a century and a half. In the deadliest grip of the death struggle, I ask for the sympathies of England in favour of the Heratis.

DISCUSSION.

Captain Cameron, R.N., said there was no man living better able than Colonel Malleson to tell the story of Herat and the value of it, but there was one thing he had left out. During the days of the early prosperity of Herat, it was the great centre of traffic between the east and west, and it would never have lost that position if it had not been that, gradually, water traffic had taken the place of that by land. In the days of the Armada a question was asked how could we send English troops round the coast quicker than the Spanish ships could sail, and it was simply our sailors launching themselves on the floating castles of Spain which drove back the invasion; but those ships were floating lubbers compared to a modern clipper. Since then our ships had sailed round the Cape, and the Suez Canal had been opened, and by degrees carriage by sea had outstripped that by land; but no doubt by the progress of science, land carriage would again be rendered superior, and then Herat would be one of the great centres in the commerce of the world, and at no distant date there would be no portion of commerce between the east and west—which was our birthright, and belonged to us as the owners of India—that did not pass by Herat. The land communication, whatever it was, would pass probably at some future day by Kandahar, which was now being joined to our Indian system of railways on to Herat, Ispahan, and Bagdad, to the Mediterranean. The Russians were making every effort to make railways through Central Asia towards India. It was simply a question of commercial rivalry, and had nothing to do with politics; they wanted to work their way to India and to get the whole traffic of Central Asia away from us. It lay with us to make Herat, and other places he had mentioned, stations on the route from the Mediterranean to India, and so to hold in our own hands the commerce bequeathed to us by our ancestors, and which we must hold if we were to retain our great-

ness as a nation. Some supposed that the Russians would be likely to take a railway by Teheran and Tiflis to Poti, but ships which went there would have to go through the dangerous navigation of the Black Sea, the Bosphorous, and the Dardanelles, whereas, if we had Herat, the navigation would be much shorter and safer.

Lieut.-Col. Hardy, R.A., thought the meeting had been a little misled by the map on the wall, which did not seem quite correct. Captain Cameron spoke of Bagdad, Ispahan, and Herat, and such places as if they only had to make a railway across a level country, and have done with it, and then they would have acquired all the commerce of the country. This was rather a sweeping assertion. The country round Ispahan, and between that and Herat, was a desert, and always would be, and had never been populated to any extent. To talk about making railways from Ispahan to Herat, and Herat to Bagdad, was absolutely absurd, in his opinion. Col. Malleson spoke of the Afghans as not being strong enough to maintain the peace of the country around Herat, but omitted to mention that in 1845, Jah Mahomed certainly did hold Herat by a very firm hand, and there certainly was peace and prosperity in the country, to a certain extent. When he was at Herat twenty-three years ago, there were certainly no traces of prosperity in the neighbourhood. The whole country had been swept, and even the young plantations were absolutely cleared away, the channels of the water-courses were entirely destroyed or allowed to fall into decay; and, to make the valley fertile, as it was many years ago, would require millions of money, to restore the irrigation schemes of the old conquerors of the country. With regard to Merv being a good outpost for Russia, why should the Russians go to Merv at all, while they can go to Sarrakhs and mask Merv altogether. If they marched eastward from the Caspian they could mask Merv, and avoid 70 or 80 miles of desert; at least, he believed so. With regard to making Herat impregnable, he thought few people had any idea what Herat was really like. It was a square mud fortress, of about a mile in length on each side, on a mound of about 80 feet high, with a wet ditch all round it, and round towers at intervals. It had a double post and rail on the slope of the rampart, which was certainly very high, and looking down from it into the city below at a depth of about 80 or 90 feet, some places even higher than that. The wet ditch was about 20 feet deep, had water in it all the year round, and the country could be flooded at pleasure. Still, in spite of that, the town was commanded by hills within 300 or 400 yards, and, unless these were brought into the *enceinte* of the town, they would always be available for attacking forces with modern siege artillery. There were 50 or 100 forts in India far more impregnable than Herat. It was simply a square mud tower, with a small citadel at the north-west corner, if it could be called a citadel. He wished to ask Col. Malleson what country he alluded to as westward of Herat which an army would march through in marching on Farrah. He understood him to speak of a fertile country westward of Herat.

Col. Malleson said that was a mistake.

Lieut.-Col. Hardy said he had misunderstood him. He assumed it meant the country of Gorian, which was a continuation of the fertile valley of Herat, because further westward was the desert of Ispahan. Then he would ask whether it was proposed that we should give Herat up to Persia, because that seemed to be the upshot of it all. They must remember that the Persians were much worse governors than the Afghans, taking them all round; they were just as bloodthirsty when they had the opportunity, and as treacherous; in fact, they were the very worst civil governors possible. Therefore, he thought we must not call the Afghans all these hard names and keep all our soft words for the Persians, who, to his mind, were just as bad.

Mr. Hyde Clarke thought the last speaker had dealt rather hardly with Col. Malleson and Capt. Cameron. Whether there were any errors in the map or not, Capt. Cameron had just returned from a survey of the proposed line of railway, from the Mediterranean to the Persian Gulf, and he had had to take into consideration its connection with Persia. Even in that room they had had evidence given that if they made use of the Karrum they could get on to the plateau in Persia to which the gallant colonel referred; and surely the fact of any portion of that being a desert was not an objection to a railway. Undoubtedly, if that connection with Persia on the south were made, instead of what might be called a Russian connection from the north, the valley of the Heri-rud would be accessible for purposes of general communication. They must agree with Capt. Cameron that the fall of Herat, like that of many other cities in the East, was due to the gradual change of traffic from the land to the sea; rather than to political circumstances. Col. Malleson had referred to what Vambéry had told them about the Tekke Turkomans, and he trusted that in a few weeks they would have Professor Vambéry himself amongst them to explain his ideas on this subject. He considered these tribes more nearly allied to the Turkish races which founded the great kingdoms of the East, than to the other Turkoman races. It did certainly seem desirable that something should be done in order to turn the good qualities of these people to account, and thereby weaken these evil qualities, which, it might be hoped, were rather transitory than permanent. The members of that race had proved themselves in many cases the promoters of commerce, and had adopted the civilisation of the countries in which they had settled. The great varieties of population in that district had been described, and if our officers could put themselves in communication with the Turkoman populations, it was quite possible that, without any expenditure of money, or any warlike operations, but merely by moral influence, we might do considerable good both to those populations and ourselves. It had always appeared to him that the Government of India had much neglected these means of communication with the Turkoman population to the north. It would be very useful if the Turkish language were made a subject for examination for Indian officers, and if means of instruction in it were provided in India. There was there present a very distinguished Turkish scholar, Dr. Leitner, chief of the Lahore College, and it did appear very desirable that, during his stay in India, his services should be utilised by the Government in the sense of peace and civilisation, which they were all desirous of advocating, however necessary it might sometimes be to resort to war as a means of defence.

Mr. Peters said it did not appear to him that Lieut.-Col. Hardy had intended to deal hardly either with the map or with the paper.

Mr. W. P. Andrew, after speaking in complimentary terms of the paper, said there were one or two points which must be mentioned. With regard to invasions of India; he thought the gallant officer would agree with him that any invasion of India now would be a totally different matter from what it had been on former occasions. When the invaders of the north came into India, they met in India a disunited and feeble people, but if anyone came from the north now, they would meet a gallant British army, well equipped and ready to give a good account of any enemy which came down the passes. He felt certain that if any hostile force were rash enough to enter India in that way, they would never go back again. Captain Cameron was interested in the Euphrates railway, and would rather lead them to believe it was better to go round about through Persia and get to Bagdad, than to adopt the method which he (Mr. Andrew) had been advocating for a quarter of a century, of going from the Mediterranean to the head of the Persian Gulf.

However, he did not wish to go at any length into the question, and begged leave to move a cordial vote of thanks to Colonel Malleson for his interesting lecture.

Mr. Peters seconded the resolution, which was carried unanimously.

Col. Malleson, in reply to the remarks which had been made, said he did not dispute that the Russians could advance on Sarrakhs without going to Merv; the reason why he alluded more particularly to Merv must be patent to everybody; it was because the Russians had declared their intention of marching on Merv. They had not dared to say they would march on to Sarrakhs, and attack a city belonging to a friendly power; he took it, that it was quite plain that to march on Merv was merely a pretence for marching on Sarrakhs and Herat. With regard to the impregnability of Herat, the gallant officer had an advantage over him, because he had seen it, whilst he (Col. Malleson) had not, but it had stood longer sieges than any other town in Central Asia; it never stood a siege of less than seven months, and only in recent times, Herat, defended by the gallantry of a British officer, repulsed a Persian army led by the monarch of that country for eight or nine months at the very least. It might not be a strong place, but on such a point anyone who undertook to lecture could only rely on the authorities, and they all described Herat as an exceedingly strong place. Ferrier, who was a colonel in the French army, described it in great detail, not as one of the Indian forts, but as a place of enormous strength. Captain March, who visited it much later, spoke of it as a place of no ordinary strength. He had not referred to Gorian at all: the only country westward of Herat, which he did refer to, was the country to the west of Farrah, and as for giving Herat up to Persia, he never dreamed of such a thing for a moment. Mr. Andrews, thought an invasion of India, at present, by a northern power, would not be so formidable a matter, as in the times of Nadir Shah and his predecessors; but he had left out of his calculation the fact that an invader from the north would never think of invading India unless he had enlisted in his train the Turkomans, who would form the vanguard of his army, and would be strong enough, supported by the European troops of the Russians, to sweep everything before them. Such would inevitably be the case unless we took up one of those strong positions which the ancient defenders of India had proved were the only positions from which they could defend the country with advantage.

The Chairman, having drawn attention to the maps on the wall, which, though made for different objects, pointed to the same conclusion, said the argument which Col. Malleson had developed showed that the great difficulty in the way of advance of a power from the north against India, before either of the cities spoken of was immediately attacked, must be the presence of any tribe of plundering horsemen on their flanks. Russia seemed to have in view, in her late attack on the Tekkes, the destruction of a tribe which occupied precisely that position. The Russians did everything they were about with a thoroughness and energy which were two of the very few qualities they possessed worthy of imitation. If we relied on the glorious past of the British army, and said we could not be attacked in our rich Indian possessions, we should go a long way towards tempting an enemy towards them. Our experience of late wars, and the difficulties of transport, and of other matters, which prevented the accumulation of large forces, did not lead to the belief that a great number of troops were always available wherever they were wanted by England, and to rely on that, and not to rely on fortified defence, would, to any military man, be an error *ab initio*. Whether Herat was the proper place for offering a prolonged defence must be decided by engineers on the spot. With the modern advance of artillery, the tendency certainly was to abandon all such places as formerly would have been considered places of strength, and to resort to extended entrenchments, as offering greater advantage both for attack and defence than any of the hill forts which used to be called strong places. The modern range of artillery had rendered it inevitable that such places would be destroyed in a very short time if made the centre of a concentrated fire. The maps on the wall both showed that Herat occupied an important central position. Could anyone believe that for the sake of occupying Merv the Russians were going to move an army of 36,000 men? He could only admire the faith of anyone who believed such an assertion. It became us to do all we could to avoid such contests, and if we were prepared for them, and said distinctly that such a thing as the advance of this army would not be allowed, there would be a great tendency on the part of every one not to try it. But they could not expect Russia or anyone else who had an object in view to stop until they were stopped. Whatever might be the feeling with regard to the different questions necessarily involved in this subject, he was quite sure that any body of Englishmen derived an enormous benefit from being instructed on these matters. A great many wars in recent times would have been avoided had such instruction been available at once to an English audience; they would not have taken up wrong issues, or fancied things existed which never had any existence at all. Gentlemen who came forward to give the British public—who were now the governors of Great Britain; he might say, of the Greater Britain, which comprised India — deserved their warmest thanks, for they prevented them from falling into serious errors which might readily imperil the whole empire. Whether Captain Cameron was right with regard to the future superiority of railways over sea traffic was he thought open to considerable doubt. There was an old proverb amongst many men that the cost of goods carriage was 1d. per ton per mile run, and he did not think that amount could be materially reduced on such a line as was advocated. On the other hand, he thought great improvements were on the eve of being adopted in sea traffic, principally by getting steam generated at a less expenditure of fuel. He very much doubted whether railways would ever supplant the sea as a means of transport, and for his own part he hoped it would not, because if so, the great portion of the wealth of the world which had hitherto passed through these British isles must necessarily seek shorter routes by land. If England lost her maritime supremacy, her power would cease to have a *raison d'être*, but he hoped that day would never come.

FOREIGN AND COLONIAL SECTION.

Tuesday, February 3rd, 1880; W. C. Sergeaunt, C.G.M., in the chair.

The paper read was—

THE COMMERCIAL AND SOCIAL PROSPECTS OF THE TRANSVAAL.

By the Rev. George Blencowe.

A glance at the map will show that the Transvaal is a country whose longitude is equal to that of the Free State, Natal, and the Zulu country, and whose latitude is of nearly equal extent. When it is further remembered that the elevation varies from 3,000 to 7,000 feet, and that there is every variety of surface, from rolling plain to clusters of rugged and precipitous mountains, it will be seen that only the most

general and indefinite climatic, agricultural, or biological description can be applied to the Transvaal as a whole. For an adequate conception of its capabilities, a detailed examination becomes necessary.

The traveller who has for ten days moved over the treeless undulations of the Free State in his way from Natal, and has become wearied by the monotony of his narrow and bare horizon, finds himself suddenly on the verge of a paradise, as he enters the valley of the Vaal river, plentifully studded with numerous kinds of mimosa, which have every variety of sylvan beauty in the diversity of their grouping, the freedom and irregularity of their growth, and the grand or lowly positions in which the architecture of the valley has placed them. Here he finds the angular and precipitous hills of the Drakensberg giving place to ranges of a dense white quartose rock, beautifully rounded so that the most eminent, by the enlargement of their curves, bend to the more lowly, and that all combine to present a scene of loveliness which is in harmony with their beautiful drapery. And when he has become acquainted with the few farms in the bottom, he learns that the fertility is equal to the beauty. Fruit of all kinds abounds, wheat, mealies, and forage flourish, and tobacco attains a full growth and high quality. This is by far the best entrance to the Transvaal, the one which gives the most adequate idea of its capabilities as a whole.

When the valley of the Vaal has been passed, and an intervening ridge crossed, the traveller comes to the Mooi river, which has not the beautiful accessories of the Vaal, but flows through an open country between deep banks, so that, but for the fertility it carries on its borders, there would be no indication of its existence until upon its edge. The value of this river, however, can scarcely be exaggerated. It has made Potchefstroom a town of mills, and the district the most abundant wheat district of the country, and has in neither respect exhausted its resources. To the south-west of Potchefstroom the surface is undulating, and in some cases, is for many miles without water, the supply going here, as well as more fully to north-east, entirely beneath the surface. This underground drainage makes a large portion of the Potchefstroom district of small value, except for grazing purposes in the summer. With this exception, the district is well suited to all the purposes of a farmer, both in climate and soil. When the population has so increased in number as to require the occupation of the drier parts, some means will be devised to bring the subterranean water to the surface, or to preserve that which falls so abundantly from the clouds in the summer. For the present, there is no lack of sites on which to establish farms, well supplied with unfailing streams.

The fertility of this district is very apparent. Timber and fruit trees grow with great rapidity. The willows of Potchefstroom, after twenty years, presented a trunk and top which rivalled our park oaks of one hundred and fifty. The high temperature and abundant supply of water during the summer, and the rest and frosts of the short winter, seem to present the most favourable circumstances for a healthy and rapid growth of timber. There are, as yet, few vineyards, and these only used for the production of grapes for sale, and for the use of the family. Fruit of all kinds abounds, and attains to great excellence. I have seen in one orchard in this district, plantain, orange, lemon, pomegranate, quince, vines, peaches of various sorts, nectarines, apricots, apples, pears, plums, figs, almond, and walnut, flourishing side by side. When such attention has been given to pruning, and the propagation of suitable and superior varieties as advanced culture brings, the fruit of this part of the Transvaal will not be surpassed by that of any country in the world. The wheat grown in all parts of the Transvaal but the Wakkerstroom district, is that which is commonly known as "Klein Corn." It is a white wheat, of not quite so large a grain as our best samples, but equally plump. The bread made from it has a yellow tinge and delicious flavour. I am not able to give the average yield, but from what I have seen, I think it is equal to the north of Natal, which, with anything like cultivation, gives ten muids or thirty bushels per acre. Forage, or oat-hay, grows freely, and has hitherto escaped rust. Mealies also yield an abundant crop. The whole district is suitable for cattle, but it is not well adapted for sheep. Horses require great attention in the summer, but horse-sickness is not as prevalent or fatal as in the northern parts of the country. The only mineral of value is coal, which is found near the Vaal river, a little to the east of the junction of the Mooi river.

To the north of Potchefstroom lies the Rustenburg district, bounded on the south by the Magalisberg, a range of hills taking a general course east and west, but with individual curves in nearly all directions. These hills are the effect of upheaval, which, in some parts, has evidently had its centre of energy far beneath the present surfaces, as we have in some cases lines of cliff of many miles in length, raised nearly in one plain without much cross fracture, and pitched from 30° to 40° through a depth of from 300 to 800 feet. These have frequently a back slope of several miles, and occur in two or three succeeding ridges, which, but for their perpendicular face, would present the appearance of huge waves suddenly solidified. Near the centre of the range, these long lines of upheaval are met by clusters of hills at all angles to their course, and of great variety of substance; some of sandstone, like the Magalisberg proper, some of soft white or pink shale, and others of lava and trap. In a few cases there is a strange mingling of all within a short distance.

In these hills the valleys are broad and open, with sides sufficiently flat to admit of cultivation almost from top to bottom. The soil derives its character from the rock whose decomposition has furnished it. The white sandstone gives a loose and useless soil, on which only short scrub and sparse tufts of grass grow. But where the sandstone is mixed with shale, it has produced a soil which is easy to work, and yet sufficiently tenacious to hold manure until it has been taken up by the plant. The best soil, however, is the result of decomposition in trap, sandstone, and shale, and is capable of producing heavy crops of grain, and so far as it has been tried, is equally well suited for any other kind of growth. All the valleys of this district are well watered, but the fountains are, as would be expected, in the back slope of the upheavals, and not on the face.

This is the most tropical part of the Transvaal that is generally occupied, and its productions are wheat, mealies, tobacco, sugar, and fruit. Sugar is grown by the farmers from a small cane, which, I suppose, must be a native of Africa, as it is unlike the kinds grown in Natal, and as it was grown before sugar was cultivated in Natal. It differs from the Kafir "imphie," as much as from the Natal cane. Coffee is grown in favourable places, where well sheltered from frost; but a plantation of several acres, which had come near to bearing, was entirely destroyed by frost seven years ago, since which time no attempt has been made to cultivate it, except in the few trees raised on a Boer homestead for ornament. This district is not suited to sheep, horses require great care, and in some of the hot, close valleys, calves are with difficulty reared. In the broad open valleys and plains, however, the cattle thrive. At one place, just on the southern edge of this district, gold has been found; but so far as I have seen the northern side of the ridge, the country is too modern to expect it there; nor do I know that any other metal has been found there, in condition and quantity, likely to pay for working.

To the west of Rustenburg is the Marico district, which has the reputation of being dry and hot. But few Boers occupy it, and it has, consequently, been chiefly of value as a starting-place for traders to the interior.

To the north of Rustenburg is the Waterberg, which, I am informed, is a fine country of high hills and broad valleys, well supplied with streams. Cattle are said to thrive, and all agricultural operations are carried on with profit. The great drawback to this entire district is, that it has never really belonged to the European occupants, and as the natives have increased, they have claimed the land in greater and greater extent, so that now the white residents are only able to remain by paying a tax to their chiefs. Unless the present Government are able to make some such distribution of the land between the natives and Europeans as took place in Natal, this and the Zoutspanberg district will have to be abandoned to the natives.

Pretoria is the central district of the country, and partakes very much of the character of those parts of the Potchefstroom and Rustenburg districts which march with it. Its soil is generally sandy, with broad flats of black pot-clay, and occasionally the fine mingled soil I have already described, while here and there a mile or so of red-brown, stiff, clayey soil is seen, capable of producing anything. The misfortune is that these portions of the country are covered, more or less fully, with broken-up trap, from the decomposition of which the soil seems to have come. With the exception of the Magalisberg, this district is free from mountains, and consists of broad undulations suitable for cultivation, for which its climate is especially adapted. The whole district is capable of sustaining large herds of cattle, as the grass is abundant, and is not as completely dried up by frosts in the winter as in some other parts of the country.

Lead is found in small quantities in the neighbourhood of Pretoria in the form of *galena*, in its quartz matrix. I have not seen the lode from which it is taken, but from the reports I was able to obtain, I gathered that, like all others I have seen or heard of in the country, it is only a fragment. This is the case with a deposit of copper in the same neighbourhood, a fine specimen of green carbonate from which was shown me by Mr. Jeppe. Gold has been found about 20 miles west of Pretoria at several places, in a valley which, from the first, attracted the notice of the diggers as they passed through.

Travelling eastward the Middleburg district is reached, which, in its south-eastern half, consists of broad undulations of several miles breadth, generally with a good stream of water in the valley, sufficient to supply as many farms as may put their homesteads on its sides. Sheep and cattle thrive, although, from the practice of burning the grass, the farmers find themselves under the necessity of moving with their stock into the deep valleys to the north in Mapoch's country, and the neighbourhood, where, although they have farms, they are obliged to pay "black-mail" to the native chiefs. This district has hitherto been but thinly peopled; many farms, however, have been purchased within the last seven years by intending settlers, and many more are likely to be occupied as soon as the country is quiet, as the agricultural capabilities of the district surpass those of any other part of the Transvaal.

The north-eastern part of this district is very mountainous, the hills rising from 500 to 1,500 feet from their base, with valleys of various breadth between. Some of them are rugged, a few inaccessible, and some have sides not too steep for grazing. Many of them contain very rich iron ore, and some are intensely magnetic. The whole of this broken country is rich in metals; cobalt, copper, and gold have been found in it, with but little search, and coal has lately been discovered a little to the south-east of the town of Middleburg.

North-eastward of Middleburg lies the Lydenburg district, which, with the exception of its southern fringe, is entirely mountainous. The scenery in this part of the Transvaal is grand, beyond anything I have seen in South Africa. When a sufficient elevation is attained, the traveller can look upon fifty miles and more of mountains, of all sizes and shapes, frequently more than 2,000 feet from foot to crown, now appearing as though running in ranges, and then seen end on as isolated towers; here, rounded off in graceful curves, and there, standing up in perpendicular angularity. Many and long inspections of such prospects do not exhaust the interest, nor diminish the pleasure. But what is their value? The more northern parts have not yet had European occupation, but where and so far as these have been approached, the broad valleys are most fertile; the hillsides, where accessible, furnish nutritious grass, and the climate is healthful for all kinds of live stock, horses excepted, which have to be carefully stabled in the summer. The agricultural excellence may be seen in the fact that a muid of wheat from one of these valleys obtained a gold medal at the first Paris Exhibition.

The Lydenburg gold fields are in these mountains. Pilgrims' Rest, the most important as yet discovered, is a valley running up four miles from the Blyde river in an easterly direction, to an elevation of about 2,000 feet at the upper end. The average depth from a mile east of the Blyde is about 1,000 feet. The present surface is covered with soil, from which

grass and an abundant and various herbage grows. But down below the present surface, in some cases, at the depth of 30 feet, there is the site of an old stream, strewn over with fragments of lava, from one to twenty feet square, which have been triturated and ground by the force of the current, till all the smaller ones are rounded and the larger are deprived of their angles. It is here on the upper edges of the larger stones that the gold of the original stream is found. But the gold is not confined to the original stream, but has been discovered on the shoulders of the minor ridges and on their tops, where it has not been subject to trituration or any abrading power. On both sides of the Blyde, gold has been found in paying quantities, over an extent of not less than eight miles square. There has been no registration of the gold found, so that it is impossible to say how much has been obtained. But in January, 1874, the Gold Commissioner, who had been in California, Australia, New Zealand, and other fields, told me that then, more gold had been taken from Pilgrims' Rest than from any "creek" in New Zealand. Similar statements were made to me by men who had been gold-digging in various parts of the world during more than thirty years.

Immediately over the eastern ridge of Pilgrims' Rest, Mac Mac, another field is reached, in which there is no trace of the same kind of violent volcanic or aqueous action. The gold is neither molten nor rusty, but bright and angular, as if it had just fallen from its quartz matrix. Many of the claims at Mac Mac have yielded well, but the extent of rich ground has not been equal to that in Pilgrims' Rest. Twenty miles further on, in the same direction, is Spitz Kop, a solitary hill, around whose foot some good finds have taken place, but full occupation has been prevented, by the unsettled state of the country from a few months after digging was fairly commenced. To the north and north-east of these fields, a large tract of territory extends, which is supposed to contain large quantities of gold, but which has not been examined because of the hostility of the native occupants. More than a hundred miles to the north-west, at Esterling, a rich reef was discovered by Mr. Button eight years since, and alluvial gold was obtained as far south as the Komati. So that there is a distance of two hundred miles east and west, and the same distance north and south in which gold has been discovered by the imperfect mode of search which has thus far been practised. This part of the Transvaal may, therefore, be regarded as presenting great auriferous promise, which, if fulfilled, will probably make this the most prosperous district in the country.

The eastern edge of the Transvaal, to the south of Lydenburg, is occupied by the Wakkerstroom district, whose average height is 5,000 feet, with hills rising more than 2,000 feet above that level. Independent of the mountains on the south-eastern side, this district consists of high broad plains, that, although cold in the winter, are especially suited to cattle, which, when acclimatised, remain fat all through the winter. This is the only good horse-breeding district in the country. Summer crops are abundant, but the cold is too severe for the winter-grown klein corn, cultivated in the other districts. The wheat of this district is of inferior quality, known as Victoria, but as it is not liable to rust, and can therefore be grown in the summer, it is the only kind at present cultivated. These hills are the sources of the Buffalo, Pongolo, and Vaal rivers, whose many streams water the whole abundantly. Coal abounds in every part, but it has scarcely been used for domestic purposes, the inhabitants contenting themselves with their sparse supply of wood, and cow-dung.

Utrecht is the most southerly division of the Transvaal, and the smallest. It differs but little from the Newcastle district of Natal, and was originally obtained by the Wakkerstroom Boers as a place for winter feeding for their stock.

On the east of Wakkerstrom lies the Heidelberg district, which is a succession of fertile valleys and plains, with ridges of moderate height running in various directions through them. It more nearly resembles the Potchefstroom district, which it joins on its western side, than any other part of the country, but has a more uniform and abundant water supply. The farms, which have been long occupied in this part, show signs of advancement, which augur well for its continuous improvement.

It will thus be seen, from this short review of the several districts, that the Transvaal has large and varied agricultural capabilities; that it is well adapted for the stock farmer; and it may be added, that it is free from the droughts which so seriously interfere with all farming operations in the Cape Colony and the Free State. As a whole, it is not so well suited for sheep as the Free State, but the high lands in the eastern central part have already some good flocks, and are capable of sustaining them in health and vigour over their entire extent. The mineral wealth of the country is very great. Coal abounds over the south-eastern portion; iron ore of the richest kind is in great plenty through the north-west; lead, easily wrought, is found in Marico; while copper in small pieces is picked up all over the country. Coal, iron, and gold, the three most precious treasures of the earth, are the most abundant. All these elements of wealth, combining with a salubrious climate, and almost unlimited food-producing power, has often suggested to my mind the thought, that the Transvaal is destined to be the workshop of South Africa.

The Transvaal has a very small supply of timber, and what it has is inferior to the same kinds grown in the Cape Colony, and in some parts of Natal. This, however, need not be a difficulty in time to come, as the various kinds of gum grow with great rapidity, and the timber is suited for furniture, implements, and building. The growth of trees is likely to be a most profitable investment of capital and labour, to any one who has the foresight to discern the needs of twenty years hence.

Only a few years since, the southern parts of the country were covered with game. Blesbock, wildebeest, quagga, and springbock, were in thousands, but now only a few are seen at long intervals. Millions have been shot, and the rest have been so disturbed in their pasturage, and so frightened by the death roar of their fellows, that they no longer take this and the neighbouring States as their winter haunts; and with the herbivorous game have also passed away the lions, hyenas, and panthers which fed on them. These may be regarded as extinct in the southern half of the country, only a solitary panther now and then appearing in the winter, to commit depredations

on the goats, sheep, or calves. This may be a cause of regret to the sportsman, but the settler is glad to be rid of such numerous trespassers and consumers of his crops, and the country at large is relieved from a low form of vagabondism, which prevailed among many of the young and idle, who preferred to subsist on the precarious produce of their guns, rather than follow any course of continuous labour.

The clearance of the country here alluded to is the second which has occurred within present memory. Somewhere about 1825, Moselikatsi swept through the country from the present Lydenburg district through Middleburg, Pretoria, Potchefstroom, and the south of Rustenburg, killing the old and capturing the young, and the cattle. In many parts of the north-east, the remains of their kraals still met with show that the inhabitants were numerous, and that after the manner of other tribes of the Bechuana race, they congregated in towns, some of which must have contained thousands. But numerous as they had been, the land was as completely deserted as Natal, by the devastation of Tshaka; and in this condition it remained till occupied by the Boers. Repeated inroads of Zulus for the plunder of the northern tribes made them also poor and few, but did not succeed in breaking their hold of the country; so that within the magnificent border lines of the last map, but few were found to claim or occupy the land. A grand estate, therefore, was that in which by right of discovery the Voor Trekkers installed themselves.

The emigrant Boers, although speaking the Dutch language, and commonly called Dutch, were really more French than Dutch. In 1688, a band of French Huguenots, to the number of 160, who had previously taken refuge in Holland, were sent by the Dutch East India Company to the Cape, that they might cultivate the land, and thus make it of greater value to the company. But from the time of their departure from Europe they were the servants of the company, who ruled them in every thing, and made them understand that they were there, "not for the enrichment of themselves, but of the company." Thirteen years after their arrival, their own Minister was re-called, and a Dutchman, who could speak enough French "to give consolation to the aged," but who was to preach in Dutch only, was sent to take his place. Eight years more and French was forbidden in all communications with the Government, and in 1724, the lessons were read in church in the French language for the last time. The only purchasers of their produce were the company, and they could buy only in their stores, and at prices fixed by the company, both for purchaser and seller. All their Ecclesiastical Acts were equally under the control of the Government, so that they could not dispose of their Poor Fund but by permission of their commander. No men would voluntarily submit to such despotism as this, but especially would it be repulsive to those who, for several generations, had renounced all their possessions and risked their lives for liberty and religion. When, therefore, after expatriation for liberty, they found themselves in danger of losing it entirely, it can scarcely be matter of surprise that they took the only means of maintaining it. While under the eye of the Government there was no possibility of escape from its grasp, so, to effect their emancipation, they went into the wilderness, and only returned to the stores when their supplies were exhausted. Each family, as it attained maturity, sent out its band of settlers to choose each one for himself a new centre of operations, where his enlarged circle would not interfere with that of his neighbour. And, as their principal employment was cattle farming, neither their own hopes nor their condition required them to curtail their boundaries. Thus it was, that by the end of the last century the Boers had spread over the country northwards nearly to the Orange River, and on the east to the neighbourhood of the Great Fish River. It cannot be supposed that the company would willingly give up their prey; accordingly various repressive proclamations were issued, which there was no power to apply. In the few cases in which they attempted to enforce their regulations, opposition was shown, and a compromise effected. Thus they drifted out of the range of law, each patriarch being the ruler of his own household, and had their church only as a common bond of union. The order of the Dutch Reformed Church is Presbyterian, which furnishes opportunity for the more intelligent and godly laymen to take part in the conduct of its affairs, in the offices of churchwarden, deacon, and elder, thus giving the most influential of the members an interest in the community, and supplying to the rest advisers and sympathisers in the difficulties of life. The living operation of this union caused every man to prize his church beyond every other known organisation, and to strive by all means to attain, and to maintain, membership in it. But as the law of the Church requires every member to pass an examination in the facts and doctrines of the Bible before his admission, so every father felt it to be as much his duty to teach his children to read as to feed and clothe them. Thus their church life presented a barrier to the barbarism to which their circumstances would otherwise have tended to lead them. They had only two books, the Bible and Psalter, and these almost necessarily led to a sharply-defined dual mental life, one side occupied with their farms, and the other with the glorious facts and revelations of Scripture. But it also, almost of necessity, inclined them to narrow and one-sided interpretations of Scripture, and unsuitable application of its teaching to every-day life. And it must be remembered that, there, alone in the wilderness, they were removed from all those improving and expanding influences which filter down on us through our intercourse with each other. They had only the vague traditions through several generations of a similar influence when at its weakest, for neither in theory nor practice had the Reformed Church thrown off all the crude heathenism which had accumulated during the "dark ages." I refer to these facts, because it is impossible to understand Boer character without a knowledge of their religion, which was sincere and earnest, but disfigured and weakened by false deductions, such as, I think, their circumstances fully account for. And I judge, from the hold they have kept of the important truths of Scripture, and from the limited circle of their literature, that now, when they are coming into rank with us, we shall have to put forth all our strength to keep ahead. I am unable

to join in the cry which I have often heard against the stupidity of the Boer. I have the honour of acquaintance with many, and I think that, considering their circumstances, they are equal to my own countrymen in general intelligence, in the improvement of their opportunities, and in integrity of character. The only class of our own population with which we can fairly compare them, is that of an agricultural village fifty years since, and with such, although the odds are against them, I do not fear the issue.

I have not time to describe the circumstances of occupation by the Boers, but will confine myself to a consideration of their character, as seen before and after. From all the facts I have been able to learn, I have come to the conclusion that the leaders of the emigration, and the bulk of the people under them, were sincerely religious and honourable men. In illustration, I can point to many of their united public acts, and to many of their number whom I have known, and who have preserved through a long life the respect of their neighbours, black and white, English and Dutch. But such an exodus as took place from the Cape Colony, would be sure to carry with it all the restless and lawless; the contests with Dingaan, and more especially with the English in Natal, would tend to increase the disposition to lawlessness, while those in whom it was strongest would be the most unwilling to remain in the Orange River Sovereignty and Natal, where British rule then was. Thus, by natural selection, an undue proportion of the lawless were among the first occupants of the Transvaal. And from this cause it was that the landrosts were unable from the first to enforce law, when it operated against a member of a large or well-supported family. From the same cause also came the establishment of three independent republics, which were only merged in the South African Republic as late as 1857. And when it is remembered that among such a people the Government had neither military nor police force for the maintenance of law, it appears that even for the preservation of social life with ever so loose a bond, there must have been a good proportion of upright and law-abiding people in the country, and that the lawless were by some means held in check. I strongly incline to the opinion that, if the original settlers had been left to themselves, and had kept from all aggression on the border natives, which was sure in the end to bring fatal retaliation, they would have been able to govern themselves, and in time would have established order. But in their condition of feebleness, the country became the refuge for the scoundreldom of South Africa, until a respectable man incurred suspicion when he removed to the Transvaal. These evil doers who found a refuge in the Republic were, in many cases, men of greatly superior education to the farmers, and thus, as well as by that sharpening of their wits which former difficulties had accomplished, they seemed the most competent for the various positions of trust and business which the Government of the country furnished. Into these positions many of this class entered, to the increase of the confusion.

The taxes of the country were the quit-rent of the farms, and a uniform duty per cwt. on goods imported. The latter was generally collected from the store-keepers, who themselves proposed the tax in lieu of the system of commandeering, which carried off their assistants and impounded their waggons. But the quit-rent was often many years in arrear, and by many was only paid when a transfer made payment compulsory. Thus the income was inadequate to the expenditure, the landrosts and other officers of the Government were unable to obtain their salaries when they could not raise them from their own districts, and the central Government was in still worse condition, so that the offices were often without paper and other requisites, and on one occasion, for several months, the *Gazette* could only be printed on what scraps of paper could be casually obtained. In this condition of impecuniosity, an attack on the natives in the Zoutpansberg district was undertaken, which all the commandeering of men and material failed to furnish with adequate support. Hence, to meet this special need, and to relieve the chronic pressure on their finances, the Government issued notes of one, five, ten, and twenty pounds, which they declared to be legal tender, but which, as might have been expected, soon sank to a small fraction of their nominal value. This speedily brought all business to a dead lock. The store-keepers could only part with their goods for cash, cattle, or other produce, and their debtors paid them in the depreciated paper, which was worthless out of the country. In 1871, some of the merchants got themselves elected to the Volksraad, and succeeded in carrying a Bill for the recall of the notes, and for the issue of another set, for the redemption of which a sufficient number of farms were transferred to trustees, who signed the new notes, and were expected twice a year to hold a sale of a portion of the farms, for which they were to receive payment in notes, and then to destroy them. This immediately raised the value of the notes, and would soon have brought them up to par. But when, in 1873, Mr. Burgers accepted the presidency, he made an arrangement with a Cape Bank for their immediate encashment. This occasioned another commercial disturbance, and in no measure increased the wealth of the country, which could not meet its ordinary expenditure, much less bear the additional burden of interest on this public debt. The result was, that they were obliged from the first to borrow money from another bank to pay the interest of the redemption loan. It was in these financial embarassments that Mr. Burgers projected his railway scheme, and involved the Republic in another debt of £100,000, for which no remunerative return has come. Immediately on his arrival from Europe, the folly of the whole scheme became apparent, and his own mismanagement patent to all. The intelligent members of the Volksraad, by dint of persevering questionings, at length brought out the admission that their land guarantee was fully pledged, that only a part of the money was raised, that all which had been nominally raised had been paid in expenses and in the purchase of plant, and that, consequently, they had not a penny with which to commence the construction of the railway, and had no means of borrowing more.

In this climax of financial perplexity, when the means of paying ordinary current expenses were absent, the war with Sekukuni was proclaimed. I

was on the gold-fields at the time, and learned, at first hand, the various steps taken by the Republican Government, and by Sekukuni and Johannes, as well as the various grounds of the dispute between the two, and the opinion I formed of the whole was that the Republic had not sufficient grounds for a declaration of war, which might, with prudence and good management, have been for that time averted. So strong was this opinion, that I requested the two officials who were in direct communication with the Government, to point out the importance of delay, as the population and available wealth of the country were small, but were increasing by settlers from the diamond-fields, by the continued working of the gold-fields, and by accessions of good men from other places, so that if ultimately the question had to be settled by war, the delay of six years would make all the difference between defeat and victory. Of the conduct and the consequences of the war, I need not speak. As soon as it commenced, supplies had to be obtained, and beyond all that could be secured by commandeering, much was needed, which could only be obtained by purchase, for which bills from one to three months were given. At maturity these were dishonoured, so that by the time the "Grand Army" retreated from Sekukuni, no one would accept the paper of the Government. When, therefore, in the entire absence of money in the exchequer, the army left the whole of the country open to the inroads of the enemy, it became plain to all capable of looking at the case, that it was simply impossible for the existing Government to continue, and that the only alternatives were universal anarchy, which would involve the surrounding territories in great danger, or the kindly intervention of some friendly power to restore order and establish security. And this was not the opinion of the English residents only, but also of the majority of the old and wealthy Boers. It was opposed, it is true, but this was by men who had really nothing to lose in the continued confusion, but who might hope to gain something in the general scramble; by men who had been mutinous and rebellious under their own Government, and especially dreaded English rule because they knew it would be real, and that their insubordination must cease; and by a few sincere patriots, who, in spite of facts which proved their impotence, still believed they could reduce chaos to order and establish permanent peace while surrounded by savage foes, from the feeblest of whom they had fled. The opposition of the first and second class was by no means tacit. But it is difficult to convey to an English audience a just idea of the imbecility shown in the credulity of the mass, or the audacity of the misrepresentations and romances of the agitators. We must, however, bear in mind, that no higher standard of education and knowledge than an English agricultural village fifty years since had been attained amongst them.

The question, however, which is of most importance to us and to them, is, does the past give hope for the future? Have these men shown, in their present and past generations, those qualities which give reasonable promise of a vigorous and prosperous future? I think the true answer is affirmative. They come of the best European stock, and, by their intermarriage, combine the pertinacity of the Dutch character with the vivacity of the French. So far as I have been able to learn, the promise of so good a pedigree has never been denied. In the Cape Colony the relatives of the Transvaal Boers have not been distanced in the course of progress by their English competitors, but keep well up with them in all ranks of life, as legislators, lawyers, clergymen, merchants, and farmers. In Natal there are examples of the same class of competence for the race of life, and I have myself witnessed as great advancement in the elegances of social life among the Dutch as among my own countrymen. In the Transvaal there are instances of most successful farming in their own peculiar line; and it should be remembered that many of the leading men among the Boers are entirely self-educated, their condition during the original emigration, during the unrest of Natal, and during the uncertainty and toils of the first years of settlement, having precluded, in most cases, any further instruction than the teaching of the alphabet by the father or mother. When men with such a beginning raise themselves to a position like that occupied by Piet Joubert, whose primer was any odd scrap of newspaper, which he studied while herding the cattle, there is assurance of a capability of progress which is full of promise.

In the face of this hopeful conclusion, there occurs the present popular disquietude and insubordination, which for the time prevent the accomplishment of anything for the general good. Rule, real, righteous rule, is the first thing necessary for the Transvaal. It has never yet existed in the country, and to many of the present inhabitants it will be most irksome, but until it is established, it is impossible for any steady progress to be made. It is quite likely that some of the leaders of the present disturbance may so far commit themselves to courses of violence as to render punishment necessary. This, however, is not likely to be the case with any of the men who have really an important stake in the country. The majority have sufficient sense to see that although none of their private rights are interfered with, their property has acquired greater security, and that the most important change has been their deliverance from the tyranny of blustering demagogues. A few years of quiet will not only make them contented with this, but will cause them to glory in it, as the only school in which their native power could find development. The only probable cause of chronic discontent is the payment of taxes, to which a Boer has great objection. He has never paid them to his own Government in sufficient amount to meet the working expenses, and such charges must now be greatly increased. What system of indirect taxation may be devised I know not, but in the absence of direct importation, and uniform customs' dues, this almost certainly will prove the most difficult problem with which her Majesty's Government in the Transvaal will have to deal.

In the proclamation by which the Transvaal was declared to be annexed to the British Crown, the inhabitants were promised that degree of influence in the management of their own affairs which was "compatible with the circumstances of the country, and the intelligence of the people." This promise will be kept, because no British states-

man, of whatever party, would have the desire or the power to break it. But it would be to keep it to the letter, and to break it in its spirit, if immediate legislative control were given to people who have repeatedly refused to discuss the conditions on which such privilege should rest, and who are only united in their determination to resist what everyone else sees to be inevitable.

DISCUSSION.

Dr. Mann, F.R.C.S., said that he wished to add a few remarks relating to the natives inhabiting the Transvaal, which he thought would prove interesting to the meeting. Mr. Blencowe, in his paper, alludes to the first settlement of the Boers in the Transvaal territory as having been materially facilitated by the country having been depopulated by the invasion of the Zulu tribes. The people who dwelt in it before that time were quite a distinct Kafir race to the one which produced the Zulus, and which is now principally represented by the tribes living in Natal and Zululand. They are spoken of by ethnological authorities in England as the Betchuana division of the Kafirs, but the synonym for Betchuana which they themselves use is "Basuto." The Basutos, as well as the Zulus, came originally from the north; but nothing certain is known of the early origin of either of these interesting South African races. The Zulus quickly advanced to the seaboard, and made themselves at home on the lower and moister lands of the coast; but the Basutos never descended below the Drakenberg Mountains, which are properly the jagged edge of the high internal table land. Before the first predatory excursions of the Zulus, the Basutos were spread over the entire stretch of country which is now known as the Transvaal. But they retired towards, and beyond the Limpopo Valley, when they became subject to hostile incursions developed out of the growth and organisation of the Zulu power. Moselikatze, who was an offshoot from the Zulu organisation in the early days of its vigorous growth, was, in the first instance, settled in the region where the capital town of the Transvaal, Pretoria, now stands; but, having attacked Chaka, he was, in retaliation, driven out by that vigorous and strong-handed chief, and withdrew, in the first instance, to the Marico, and ultimately to the high tableland which forms the crest of the watershed between the Limpopo and Zambesi rivers. After the battle of Boomplaatz, in 1848, by which the British ascendency in the Orange River sovereignty was virtually established, a party of emigrant Boers, under Hendrik Potgieter, advanced into the Transvaal region, which is now known as Lydenburg. This district had been previously occupied by a tribe of Basutos, governed by a chief whose name was Sekwati; but, at the time of the advent of the Boers, Sekwati had left this land, in consequence of hostile raids made upon him, and had withdrawn from the open country into the mountains, close to the Oliphants River, which afforded greater facilities for defence. The Boers at that time affirmed that they had beaten Moselikatze, who was the conquerer of Sekwati, and, upon that ground, assumed that they were the rightful proprietors of Sekwati's territory; but, to make assurance doubly sure, they then bargained with the neighbouring Amaswazi chief, who also had some rights of conquest over Sekwati, that he should relinquish his interest in the land for a payment of 100 oxen. The Boers say that, at this time, Sekwati admitted himself to be only the Amaswazi's dog, and professed himself quite willing to be Potgieter's dog instead, upon condition of thenceforth receiving protection against the Amaswazi at his hands. The Amaswazi, it appears, offered to clear Sekwati out of the land as a part of the service rendered for the oxen. The Boers, having thus assumed to themselves the rights of possession, proceeded to occupy the land, and do not appear to have had any opposition made to them on the part of Sekwati at first; but, in the year 1852, disputes began to arise between them and Sekwati's people, and Sekwati then took up a still stronger position, on the Lulu Mountains, and fortified it. The Boers thereupon organised themselves into what they termed the Lydenburg Republic, and had their holdings of farms confirmed to them by a formal act of its Government. Sekwati, in the first instance, harassed the intruders; but, in the year 1857, it was mutually agreed that the conflict should cease, that the Steelport River should be established as a boundary line between the Boers and the natives, and that Sekwati should give up to the Boers all runaways, offenders, and cattle that found their way over to his side of the river. In the year 1860, Sekwati died, and was succeeded in the chieftainship by his son Sekukuni, who does not appear to have recognised the treaty made with his father, for, from that time, the Boers began to pay him a tribute of two heifers a year for each farm in their occupation. The Lydenburg Republic, in the meantime, had merged itself into the larger State, which had been constituted as the Transvaal Republic. A German missionary, named Merensky, settled himself with Sekukuni in the Lulu mountains at the time of his accession. But, in 1864, the missionary was driven away by Sekukuni, with his family and all his belongings. He then settled near Middleburg, on Oliphants River, and gradually collected a following of about 1,500 Basutos round him. Amongst these men was one named Johannes, who was a brother of Sekukuni's, and who, it will be seen, became the cause of renewed conflict and trouble. The Boers continued to pay tribute until 1875; but, in that year, Johannes, for some reason, withdrew himself from the protection of the missionary settlement, and took up a hostile and threatening position upon a hill of the Spekboom River, a few miles north of Lydenburg. He then advanced a claim for land against the Boers, and, soon after, disputes occurred in reference to the right of cutting wood. Sekukuni gave active support to Johannes, and it was this state of affairs which led to the declaration of war against Sekukuni by the Transvaal Government in 1876, and ultimately to the annexation of the Transvaal State by Great Britain; 2,500 Boers, 3,000 Amaswazi allies, and a contingent of other friendly natives were called out for service by Mr. Burgers, the President of the Republic, and this force was advanced against Sekukuni to the Steelport River. Sekukuni, however, managed to capture 1,000 head of cattle from them. President Burgers attacked the stronghold of Johannes, but had to retire in consequence of the Boer portion of his command not giving adequate support to the native portion of the force. Johannes, however, was killed in this conflict. On the 2nd of August, a spiritless and altogether unsuccessful attack was made upon Sekukuni's stronghold. The Boers then precipitately retreated upon the Steelport River, and, shortly afterwards, broke up their expedition and scattered themselves to their homesteads, in this way putting an inglorious and disastrous termination to the campaign. Some not very intelligible negociations between the Transvaal Government and Sekukuni appear to have followed, for the next stage in the complication presents the victor, Sekukuni, as having engaged himself to pay a fine of 2,000 head of cattle to his defeated and baffled assailants, although it was almost universally felt that a combined attack upon the Transvaal by the united strength of the Zulus and Sekukuni was imminent. It was at this time that President Burgers found himself under the necessity of, in some way, getting hold of more land, to pay 3,000,000 acres which he had hypothecated to serve as security for the railway loan that he had negociated in Holland. It was the threatening aspect of these complications, and the terrible dread of a combined attack upon the European settlers by a coalition headed by the Zulu chief, Cetywayo,

which induced the British Government to place its *ægis* in the front of the threatened territory, and to assume the responsibility of the defence which has but recently ended in the breaking up of the Zulu military despotism, as well as in the removal of Sekukuni from his strong mountain fortress. The case against Sekukuni, which led to his downfall, was that he had himself admitted his liability of the fine of 2,000 head of oxen under his arrangement with the Boers, and that he, nevertheless, refused to pay the cattle when the administration of the Transvaal affairs was assumed by the British Government, and that he had also committed himself to a system of petty attacks upon settlers who were necessarily under its protection. Such succinctly is the history of the troubled episode which has ended with the signal defeat of Sekukuni. The present native population of the Transvaal is variously estimated by different authorities as being somewhere between 300,000 and 700,000. These people are principally of the Basuto race, but there are small gatherings of Zulus amongst them, who, however, do not look down upon them in the same contemptuous way as the larger Zulu tribes do which are situated to the south and to the north. The Zulus who are naturalising themselves in the Transvaal appear rather to be assimilating themselves to the Basuto type of life, which is less warlike and aggressive than that of the Zulus. The martial proclivities of Sekukuni appear to have been quite accidental and exceptional attributes. The Basuto, in general terms, is a less intelligent and less gifted race than that which has supplied the Zulu tribes, but it is more docile and manageable. It is more apt in constructive capacity, more easy to train to habits of productive industry, and less given to martial aspiration. By some good authorities it is, however, also held to be less reliable than the Zulus. The native tribes of the Transvaal are almost entirely withdrawn from the more settled centres of the land, because the Boers have always been adverse to their presence in any large number amongst them. When they first occupied the land, they designedly drove the natives away from their centres of settlement, and it was only after they had scattered themselves broadcast over the land, to take possession of their 6,000 and 8,000 acre farms, that the natives began to flow back to their earlier haunts. They are still chiefly massed on the Waterberg and Zoutspannsberg districts, which look down to the Limpopo river in the far north, and into which they have gathered themselves, as the Boers have made good their hold on the more temperate highlands towards the south. The special correspondent of the *Times*, writing from Pretoria on the 29th of December, 1879, states that the natives living in the Zoutspannsberg and Waterberg districts of the Transvaal amount to 500,000 individuals. They are there at the present time in some such numbers, passively waiting the turn of events; but they are by no means uninterested spectators. In the light of some recent pages of South African history, it is clear that it is to them of the most momentous importance whether their land is to be ultimately ruled by British or Boer hands. The chief produce which the Transvaal has to look to for its progress and prosperity is wool and minerals, which will, happily, both be available for export as means of internal transport are improved, and as industrial enterprise is developed. The High Veldt, which is the pasture ground for wool, comprises the whole of the upper valley of the Vaal River, that gradually, rises towards the east, to an ultimate elevation of 6,000 feet above the sea level. This highland of the Transvaal passes to the south of Pretoria, some thirty-five miles away, the town itself being on the northern slope, which subsides gently for some two hundred miles towards the Limpopo. Mr. Blencowe has specified iron, coal, cobalt, lead, silver, and gold as amongst the mineral productions of the land. The load of lead, which is alluded to as existing in the neighbourhood of Pretoria, in reality extends almost uninterruptedly for 200 miles, and is so rich in Marico that a couple of men are able to extract a ton of available ore per day.

Mr. Frederick Young said the deep interest which attached to the Transvaal at the present moment made this paper especially opportune; and it must be the impression of all who had heard it that Mr. Blencowe, who had had the advantage of traversing the whole of the country, had given most valuable information. At some part of the paper the author seemed to have diverged more into the political than the social and economical aspects of the question, which he had come especially to hear, but, just at present, all minds were much interested in that part of the question, and people could hardly avoid touching upon it. He believed it was perfectly clear that there was a great commercial future for the Transvaal. Mr. Blencowe had told them of various products which were likely to be exported, not only arising from the mineral resources, but also from the agricultural developments of the country; and on this subject it was interesting to know what British commodities would be exchanged for these products. On this point he should like to refer to something which had appeared in the *Manchester Guardian* of the previous day, showing the importance of British manufactures being of the best possible character, in order to establish a supremacy over those of other countries. A good deal had been said of late—and he feared not without foundation—about certain processes which some manufacturers had adopted in order to cheapen their goods at the expense of quality. The *Manchester Guardian* said that a discovery they had just made seemed to throw a light on the possible origin of some of the paragraphs discrediting English supremacy, and referring to the superior honesty and success of our American competitors. They had recently published an abstract from a letter in the *Nordische Allgemeine Zeitung* from a German resident in Bloemfontain, complaining that his countrymen were unable to compete in the South African markets, because of the superior quality of goods sent from England laying stress on the fact that English merchants recognised the fact that durableness was the primary requisite in articles intended for South Africa, and that in repeat orders they carefully kept up the quality even if they had to raise the price; whereas, on the other hand, the German manufacturers sacrificed quality to cheapness. In the December issue of the *American Mail and Export Journal* they found the same letter, but printed as coming from a correspondent in Berlin, only in place of the English manufacturer the American was complimented, and the Americans were credited with being the most formidable competitors of both the English and Germans. English consuls often called attention to the spirit and energy shown by American merchants in advertising, and this seemed to be a specimen of it. He took the liberty of drawing attention to this as being somewhat pertinent to the lecture. He had no doubt that the Transvaal was destined to become one of our most valuable acquisitions in the South of Africa, and he was glad to find it was being recognised in every direction that, having once annexed it, we should never think of giving it up.

Mr. Campbell Johnston, F.R.S., said the portion of the paper which Mr. Young thought the least of had made a deep impression upon him, and it was, in fact, impossible to dissociate the political from the social aspect of the question. He had read almost every book on Africa, but Mr. Blencowe had, for the first time, given the Boers their true position. He himself had traversed that country, and lived amongst the Boers for three or four months, rarely seeing one of his own countrymen during the whole time, and those he did see, he was sorry to say, were so far inferior in every good quality to the Boers that he rather shunned them than sought their company. He travelled slowly in a wagon, and he found the Boers

thoughtful and plodding, the very type of the Dutch character to be found across the Channel. In the Orange Free State, he found, thank God! a country claiming its independence. He went out to see what was the secret cause which had kept South Africa back from the prosperity usual in our other colonies; for, having a family of eight sons, he should have been glad to have established some of them there. At Bloemfontain, he found a country progressing far more rapidly than Capetown, a country going ahead, which he should have been glad for any of his sons to settle in. But in no other part of South Africa did he see the same progress, except in the Transvaal. He visited the diamond fields just at the time when a company of troops had been sent from Capetown to keep down an *emeute* which was threatened, not amongst the Boers or the blacks, but amongst Englishmen, for they nearly all called themselves such, though he should be sorry to acknowledge many of them as countrymen. Going back to Bloemfontain, he had to stay three or four weeks for his horses to pick up flesh; and going on into the Transvaal, the further you went the less sustenance could you find for horses, and by the time you arrived at Potchefstroom, you could not travel with horses with any degree of safety, and, therefore, he swapped his cart and horses for a wagon. There he had a transaction with Mr. Pretorius, who was now, he was sorry to say, imprisoned as a treasonable Boer. He could only say that he found him as honest, upright a man as he had ever met in his life, and he deplored his unfortunate position. He then went on to Pretoria, and there he found Englishmen, or those who called themselves such, who fully justified what Mr. Blencowe had said about misrepresentations and romances, and agitators; and they were then agitating the question of annexation. Such was the disagreeable and boisterous mode of life which prevailed in the houses of public entertainment, that he preferred not leaving his wagons and outspanned in the public square, where he lived for three weeks, with a Boer, his wife, and daughter, and the President of the States General, who used to spend the day with them. He went on, intending to see the gold fields, and got as far as Middleburg, but wherever he came to an inn he found the same spirit prevailing amongst the English, undermining Dutch character, and endeavouring to bring about that unfortunate catastrophe which took place. As he went on he found the country was so dry that the cattle died for want of food, in this famous rich country which had been spoken of. On the gold fields he was accosted one day by a man, who came up to him with an audacity he should hardly have deemed possible, and showed him his paper, called the *Gold Fields Mercury*, and his conversation was such that it was ludicrous to talk of treason by the side of it. Considering that he was in a Dutch Republic, he never had more treason uttered to him than was poured out by the editor of that paper; but he soon left him when he found that he could not, while receiving the hospitality of the country, join him in endeavouring to excite anarchy. Returning, he stayed some time at Lydenburg, where he saw more of the Boer character; and he agreed with Mr. Blencowe that they were not, perhaps, educated so highly as some of the rascals by whom they were surrounded. They were simple, honest, plodding people, and, therefore, in one respect, not, perhaps, to be left alone; but he endorsed the view that they could govern themselves. What then was his horror to see, by recent papers, that these people were unable to govern themselves; these people who had gone out on the Veldt and settled with the greatest tranquility. Sir Bartle Frere had testified to their love of order, and now they were called traitors; and said to be coquetting with treason. A few weeks before that, there was a meeting of some 300 or 400 so-called Englishmen at Pretoria, when one of the resolutions passed was that if her Majesty's Government ventured to return the country to the Boers, they would, themselves, form a body and prevent it; and they formed a committee for that purpose. Who were the greater traitors? Those men combining against the British Government, determined to defy it if a certain event happened—he did not say it would—or these poor Boers who gathered together in an orderly manner, and simply said, we are convinced that neither the Queen nor the people of England know anything of our affairs; we have been trampled under foot; we have sent two delegations to England which have been treated with scorn; we cannot look to England for protection; we can only rely on our own strength. Mr. Blencowe said these people were religious, upright, and earnest, and there was the secret. He also spoke of them as being remarkable because they had no police, and required none. In what part of Europe could you find a population of 40,000 or 50,000 who lived in peace and tranquility without a police? When he returned to England, he wrote a pamphlet warning his countrymen against this annexation of the Transvaal, and telling them if they sowed the plant they would have to reap the fruit. What were the consequences? The Zulu war; who could deny it. He would not go into the circumstances of the war with Sekukuni, but was it only the people of the gold field who palsied the hands of the Dutch Boer, and did everything to ruin him? Now, when Mr. Burgess was about to enter into that war, his hand was palsied by the nation with whom he had a treaty of friendship; it was England that palsied his arm, by saying—these are not rebels; you have no right to fight them; we treat them as belligerents; we proclaim the Mutiny Act; and, more than that, means were taken, contrary to the treaty, to prevent the ammunition the Boers had ordered from England reaching them. But there were other means besides military overcome force to a population of 40,000 souls. We could abuse them and decry them as we had done for forty years. The first word he had ever heard in their favour was from Mr. Blencowe. Why, when Captain Harris published his sporting experiences in the country, the first edition being issued in Bombay, he spoke of them as Boers, but in the first English edition they were called boors. So that from the beginning they were run down in the press, and why? It came from the traditions in the Foreign-office. These traditions were acknowledged by Lord Carnarvon in the House of Commons. He could not say he was controlled by them, but he said there were traditions in the Foreign-office. And in his opinion these misfortunes and annexations in all countries arose from those traditions. The question was, would Englishmen submit to be ruled by traditions which ran counter to justice, honour, and fair dealing towards the weak? He, like the Boers, was convinced that if the people of England knew the true position of things, and if her Majesty knew it, they would at least grant these people fair play, instead of turning them out of the place, when they simply came to ask for a hearing.

Mr. Mockford asked if Mr. Blencowe would state whether the Transvaal was open to emigrants from this country.

The Rev. Mr. Blencowe said he understood the question, whether the Transvaal was a suitable place for English farmers and mechanics to settle in. The answer was, unquestionably; the only difficulty was that the Government had no land, and could not, therefore, throw it open for selection and sale by public competition. The purchase would, therefore, have to be made from private holders. All about the Middleburg district the land was already alienated and much was in the hands of the speculators, but, as yet, they had not reached a very high price—say, £500. Mr. Johnston had bought one or two.

Mr. Johnston said that was before the annexation. He should be glad now to get rid of them.

The Rev. Mr. Blencowe said Mr. Johnston was mistaken in one respect. The absence of police did not arise from the law-abiding character of the people, but from the want of money to sustain it; and the absence of police prevented the maintenance of the law. He had been told by landroosts that, when they had any case against a man of a large family, and well-sustained, the only way in which they could hope to carry it through righteously was to call on the respectable Boers of the neighbourhood to attend the court armed, to prevent coercion; and, even then, several cases had occurred, within his own knowledge, in which nocturnal parties had broken open the jail, and taken away the prisoner.

Mr. Taylor said they all knew that Cape Colony was very dry, there being but little rainfall. He should be glad to know whether in this district there was anything like steady or periodical rains.

The Rev. Mr. Blencowe replied that there was. It was the best watered district in South Africa; better watered even than Natal. The only part destitute of water was near the Diamond Fields, and the part of the Potchefstroom district, where the rivers ran underground. The soil there was very porous, so that the farmers said they could not even make drains which would hold water. That country was occupied chiefly by ostriches and game. The only drawback to agriculture in the eastern part of the Transvaal was the occasional visits of locusts, but they did not come in such numbers as farther west, on the edges of the Free State, and the northern part of Cape Colony. When he was travelling there, he would get a blow in the face from a locust about once in half a mile. They made a little impression on the grass, but were not much more numerous than grasshoppers in many English meadows, only they were larger, and they committed depredations on the winter-grown corn. On the south of the Prætoria district he had seen farmers lighting fires all along the top of their fields to windward, so as to blow the smoke over the surface. He noticed one farm where the wheat was very short, and the owner told him that it was the third time it had been eaten off that year. But that was an exceptional case. Farther eastward there was no difficulty. The peculiarity of the rivers was that they took their rise at the level of the highest clouds, so that they never failed.

Mr. Mitchinson said he knew the part of the country from the Orange River to Capetown, and he was informed by the Astronomer-Royal that, from year to year, the rain on the west side of the colony was diminishing. For nine or ten miles from Capetown the district was very poor and sandy, and the agriculture very poor. The Astronomer-Royal expressed his opinion that, from diminishing rains, and the shifting sand being blown about by the heavy winds, the agriculture on the western side must deteriorate. In digging for water, from 30 to 50, or 60 miles south of the Orange River, it was necessary to go down about 180 feet.

The Chairman said the Transvaal was to him a very interesting country, as he had visited it some time ago, (but subsequent to that dreadful annexation alluded to by Mr. Johnston), on behalf of her Majesty's Government. It appeared to him to have two great requirements. First it wanted a population, and, notwithstanding what he had heard to-night, he should like to see that population consist of honest Englishmen, honest Scotchmen, and honest Irishmen, and, in fact, the energetic and useful members of every European State. He had been accustomed to listen for the last twenty-eight or twenty-nine years to very hot disputes as to the Boer character; he had frequently heard men say that there was not a single good quality to be found in a Dutch Boer; that they were incapable of speaking the truth, and that they never, by any chance, were honest in their dealings. On the other hand, he had heard them praised, even beyond what they had heard that evening from Mr. Johnson. He believed himself that, as usual, the truth would be found to be halfway between the two extremes. He knew them, and had amongst them friends whom he met after many years with the greatest satisfaction, and, judging by the brightness of their eyes, they seemed equally pleased to shake hands with him again after a lapse of 18 or 19 years. They were capable of long friendship; but they had also their weaknesses, and what nation had not? The Transvaal wanted a more energetic population than it would find in the Boers. Whilst there he had a long conversation with an Australian gentleman, who had, he believed, been delegated by some of his fellow colonists to see if the Transvaal was suitable for sheep grazing. He told him he never saw anything in his life more suitable for sheep than the high veldt, but he saw no sheep there. He asked him if he had not seen any at Oliphantfontain, and he said no. He told him that he himself had seen 7,000 there, to which the Australian's reply was—"7,000; that is not enough to pay the working expenses of the establishment." He went on to say that they wanted men of capital and energy, who would sow crops to feed the stock in winter; not drive them down into the bush veldt because the grass perished in the high veldt; and they wanted belts of trees planted to break the force of the winds, and so on. In fact, they wanted science, energy, and capital. One other thing was wanted—but, if there was a good population that would soon follow—viz., an outlet for the produce when it was grown. He must say one word for the Colonial-office—with which he had been connected for a long time—after the remarks made by Mr. Johnston. He did not think Lord Carnarvon ever stated in the House of Commons that he had adopted the policy of the Colonial-office, for Lord Carnarvon was far too independent a man to adopt any policy he had not thought out for himself. He remembered the great Lord Lytton, when Sir Edward Lytton, being once attacked in the House of Commons on account of the view he had taken with regard to the American Fisheries question, on the ground that he had not followed a policy of his own, but adopted what was then called the tradition of the Colonial-office. Sir Edward Lytton replied that he had attentively and carefully perused the voluminous papers which had been put into his hands, but that he had arrived at his own conclusions. It was true that he had had the advantage of reading the opinions of those who had made these matters the study of their life, but he had not accepted the advice they gave him without drawing his own conclusions, and if he had done so, he thought the country was rather to be congratulated that there were people to give advice to the Colonial Minister, inasmuch as, during the three years previous to that time, there had been no less than eight Ministers for the Colonies, and if each had taken a line of his own in opposition to that of his predecessor, it would be impossible to conceive greater confusion than would have been the result. He would conclude by moving a hearty vote of thanks to Mr. Blencowe for his able and interesting paper.

The resolution being carried unanimously, the meeting adjourned.

NINTH ORDINARY MEETING.

Wednesday, February 4th, 1880; Clements R. Markham, Esq., C.B., F.R.S., F.R.G.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Archbold, Ralph S., 2, New Broad-street, E.C.
Batty, Edmund, 2, Eslingden-terrace, York.
Berens, Rev. R. M., Sidcup.
Jones, Rev. Alfred, 117, Gunnergate-terrace, Middlesbro'.
Jones, William John, 7, Great George-street, S.W.
Love, Alfred, Old Shot Tower Wharf, Commercial-road, Lambeth, S.E.
Marlow, Thomas, Thorncliffe Iron Works, Sheffield.
Rutherford, J. H., School of Science and Art, Corporation-street, Newcastle-on-Tyne.
Sexton, Joseph, 3 and 4, Great Winchester-street, E.C.

The following candidates were balloted for and duly elected members of the Society :—

Barr, James, London-road Iron Works, Glasgow.
Bell, Henry, Guildford-street, York-road, Lambeth, S.E.
Berdoe, Walter, Silicate Paint Company, Charlton, S.E.
Bevan, Rev. James Oliver, M.A., Russell-house, Walmley, Birmingham.
Currie, William, Dalry-road, Edinburgh.
King, Arthur J., 53, Cannon-street, E.C.
Vernon, Walter L., London-road, St. Leonards, Hastings, and 26, Great George-street, S.W.
Whitehead, Herbert Maguire, Conservative Club, S.W.

The paper read was :—

TRADE AND COMMERCE WITH SIBERIA VIA THE KARA SEA.*

By Henry Seebohm.

The history of the navigation of the Eastern Arctic Ocean for commercial purposes may be said to begin with the unfortunate expedition in which Sir Hugh Willoughby lost his life and that of his crew on the Kola peninsula. One of the ships, under the command of Richard Chancellor, was driven into the White Sea, and was the means of opening up commercial intercourse between England and Archangel. Three hundred years ago, the semi-barbarous Slavs, who lived on the banks of the Dwina, were enterprising enough to carry on a trade with Siberia. At the head of the gulf of the Taz, between the mighty rivers the Obb and Yen-e-say, was the ancient town of Man-ga-say, the Nishni-Novgorod of the north, where a great annual fair was held, frequented by merchants from Tartary to Russia. The Eastern merchants brought their wares down the great rivers, but the Russians from Archangel skirted the shores of the White Sea, the Arctic Ocean, and the Kara Sea, dragging their flat-bottomed "lodkas" across the Kanin and the Yalmal peninsulas, choosing for the purpose localities where two rivers left only a short porterage across the watershed.

This trade died a natural death, being unable to survive the competition with England; and it was not until the year 1874 that any successful attempt was made to re-open commercial relations with Siberia *viâ* the Kara Sea. In that year, Captain Wiggins chartered the well-known steam yacht, the *Diana*, and sailed from Dundee. After cruising for some time in the Kara Sea, he satisfied himself that the navigation was accompanied by no insuperable danger, and returned in safety. In the following year, Professor Nordenskiold, of Stockholm, was still more successful. He succeeded in reaching the gulf of the Yen-e-say in a walrus sloop, which he sent back to Hammerfest, and returned himself to Europe by the overland route.

In 1876, both these gentlemen attempted to take a cargo to Siberia, *viâ* the Kara Sea. Professor Nordenskiold was the first to arrive, and, failing to find a channel up the Yen-e-say deep enough for his steamer, he landed his goods at a little village, about a hundred miles up the Yen-e-say, and returned to Europe in safety. Captain Wiggins left Sunderland on the 8th of July, in the *Thames*, Arctic steam yacht (120 tons), and entered the Kara Sea on the 3rd of August. The ice prevented him from sailing direct to the mouths of the Great River, so he spent some time in surveying the coast and the By-der-at-skerry Gulf, and did not reach the gulf of the Obb until the 7th of September. Here he lay at anchor some time, in the hope that a favourable wind might enable him to ascend the Obb against the strong current; but, the weather proving tempestuous, and the wind contrary, he abandoned the attempt and ran for the Yen-e-say. He commenced the ascent of that river on the 23rd of September, and, after a tedious voyage, struggling against contrary winds and shallow water, he finally laid his vessel up on the Arctic circle, half a mile up the Koo-ray-i-ka, on the 17th of October, 1,200 miles from the mouth of the Yen-e-say. The following morning the ship was frozen up in winter quarters, and Captain Wiggins returned to England by the overland route.

In 1875, Harvie-Brown and I visited the delta of the Petchora, in North-east Russia, and brought home an unusually interesting collection of birds, eggs, and ethnographical curiosities, from the "tundras" of Siberia-in-Europe. In 1876, Drs. Finch and Brehm made an expedition to the Obb, extending still further to the east our recent zoological and ethnographical knowledge of these interesting regions. Hearing that Captain Wiggins was in England, and likely to rejoin his ship with the intention of returning in her to Europe through the Kara Sea, I lost no time in putting myself in communication with him. I was anxious to carry our ornithological and ethnographical researches a step further to the eastward, so as to join on with those of Middendorf, Schrenck, and Radde, in East Siberia. I made the acquaintance of Captain Wiggins on the 23rd of February, and came to the conclusion that an opportunity of travelling with a gentleman who had already made the journey, and, consequently, "knew the ropes," might never occur again.

We left London on Thursday, the 1st of March, and reached Nishni Novgorod on Saturday, the 9th inst., having travelled by rail a distance of 2,400 miles. We stopped three days in St. Petersburg to present our letters of introduction and to pay some other visits. At Nishni we bought a sledge, and travelled over the snow 3,240 English miles, employing for this purpose about a thousand horses, eighteen dogs, and forty reindeer. We left Nishni on the evening of the 10th of March, and travelled day and night in a generally easterly direction, stopping a couple of days at Tyu-main, and a day at Omsk, and reached Kras-no-yarsk on the morning of the 2nd of April, soon after cross-

* The Russian names in this paper are all spelt phonetically. The only explanation required is that *kh* represents the German guttural *ch*.

ing the meridian of Calcutta. We rested a day in Kras-no-yarsk, and sledged thence nearly due north, spending four days in Yen-e-saisk, and three days in Toor-o-kansk.

For the first two days we found sledge-travelling somewhat irksome; but we soon got into the full swing of it. After having sledged a thousand miles or so, we began to feel that the process might go on for weeks or months, or even years, without serious results. I soon began to enjoy it. My sledge-fever entirely left me; and I used to find a pleasant lullaby in the never-ceasing music of the "wrangling and the jangling of the bells." However rough the road was, I enjoyed a good night's rest; and if an unusually heavy "lee lurch" or "weather roll" jolted me against my companion, we only muttered that there was "a heavy sea on," and dozed off again. Snow, wind, rain, sunshine, day, night, hills, valleys, plains, rivers, good roads, bad roads, it was all the same; on we went, and nothing stopped us. The scenery through which we passed was very various. The first 1,000 miles was hilly and well wooded. One might imagine one was sledging through an endless Sherwood Forest, with 100 miles of the Peak of Derbyshire placed in the middle to represent the Urals. The ground was covered with from two to three feet of snow. Sometimes we seemed to be sledging down a "broad drive," sometimes crossing a peak, and occasionally passing through a village. The forests were principally spruce-fir, with a little larch and Scotch fir, and plenty of birches. Sometimes we sledged for miles through avenues of birches. The Ural range is a succession of hills, which it took us some time to get through; but the loftiest peak can scarcely be dignified with the name of mountain. Between Tyu-main and Tomsk we had nearly a thousand miles of a totally different class of scenery. The steppes of South-western Siberia might be compared to Salisbury Plain. As far as the eye could reach, nothing was visible but snow, sky, and telegraph lines. Now and then we came upon a few stunted birches, and every 15 or 20 miles we passed through a village. About a hundred miles before reaching Tomsk we again found ourselves amongst hills and forests, which continued until the road permanently established itself down the broad-river.

The Yen-e-say is said to be the third largest river in the world, being only exceeded in size by the Amazon and the Mississippi. The principal stream rises in the mountains of Central Mongolia, enters Siberia near the famous town of Kyakh-ta, on the Chinese frontier, and flowing through Lake By-kal, passes Eer-kutsk (Irkutsk), the capital of Siberia, under the name of the An-go-ra or Vairkh-nya, Tun-goosk, and enters the smaller stream—whose name it subsequently bears—a few miles to the south of Yen-e-saisk. Up to this point it may be roughly estimated at 2,000 miles, and judging from the time it takes to sledge across the river at Yen-e-saisk, its width must exceed an English mile. Following the windings of the river from the latter town to the Arctic circle, the road is calculated as a journey of 800 miles, during which the waters are augmented by two important tributaries, the Pod-kah-min-a Tun-goosk and the Nizh-ni Tun-goosk, which increase the river to more than three English miles. On the Arctic circle it receives an important tributary, the Koo-ray-i-ka, about a mile wide, and, somewhat more circuitously than appears on our maps, travels to the islands of delta—a distance possibly slightly over-estimated at 800 miles—during which the average width may be about four miles. The delta and lagoon of the Yen-e-say are about 400 miles in length, and must average 20 miles in width, making the total length of the river about 4,000 miles.

Throughout the whole extent of the river, as far as I travelled upon it, from Yen-e-saisk, in lat. 58° to Gol-chee-ka in lat. 71½°, the banks are generally steep and lofty, from 60 to 100 feet above the water-level, and, so far as I could learn, comparatively little land is covered by the summer floods. In this respect it presents a marked contrast to the Obb. The villages on the banks are from 20 to 30 versts (15 to 20 miles) apart, and are, of course, built upon high ground. In the winter, relays of horses and sledges, and in the summer, of rowers and boats, are to be obtained at these villages. As we sledged down the river, we had always a heavy climb up to the post stations; and, in descending again into the bed of the river, it sometimes almost made our hearts jump into our mouths to look down the precipice, which our horses took at a gallop, with half-a-dozen villagers hanging on the sledge to prevent an upset, a feat which they performed so cleverly that, although many a peasant got a roll in the snow, we always escaped without any serious accident. We found a good supply of horses as far as Too-ro-kansk. The second stage from this town we travelled by dogs, and completed the rest of the journey with reindeer. The dogs were fine fellows, black, white, piebald, or brown, with long hair, small ears, and bushy tail turned over the back. They never seemed tired, never tried to shirk their work, were good-natured and tractable in the extreme, and are so sagacious that it is a common practice, at the end of a stage, to send the team back to the last station alone with the empty sledge. The harness is of the simplest construction possible, being nothing but a padded belt over the small of the back, passing underneath to the sledge between the hind legs.

Soon after leaving Yen-e-saisk agriculture practically ceases. A few cows graze on the meadows near the villages, and hay is cut for their use during winter, but the villagers are too busy fishing during the short summer to till the land. At Sil-o-vah-noff, however, not far from Too-ro-kansk, the unfortunate Scop-si cultivate potatoes successfully.

The banks of the Yen-e-say are clothed with magnificent forests up to the Arctic circle, but northwards the trees rapidly diminish in size, and disappear altogether soon after leaving Doo-din-ka, in lat. 69½°. These forests are principally pine, of various species. The larch extends further north than any of the other pines, and is abundant, though small, at Doo-din-ka. Further south it attains large dimensions. At Yen-e-saisk a larch pole suitable for the mast of a ship, 36 inches diameter at the base, 18 inches diameter at the apex, and 60 feet long, may be bought for a sovereign. This hard, dark wood looks very well for the walls and ceilings of the peasants' rooms.

The spruce fir, perhaps the most elegant tree in the Yen-e-say forests, with branches almost down to the root, and trailing on the ground, is still more abundant, and extends nearly as far north, say to lat. 69°. The Siberiaks look upon this tree as one of the most important for commercial purposes. The wood is white, of very small specific gravity, and very elastic, and is said not to lose its elasticity by age. It is the favourite tree for ships' masts, and is considered the best substitute for ash for oars. Snow-shoes are also generally made of this wood. The quality is good down into the roots, and it makes the best knees for shipbuilding, not requiring to be cut out of the solid or artificially bent. It is, however, subject to very hard knots, which are said to blunt the edge of any axe not made out of Siberian steel. The Siberian spruce is less abundant, and does not extend so far north. I did not observe it north of lat. 63°. It differs from the common spruce in having a smooth bark of an ash-grey colour. The leaves are also of a much darker, bluer green. It has little commercial value on the Yen-e-say, the wood being soft, and liable to crack and decay. Being easy to split, it is largely used for firewood and for roofing. The Scotch fir, with the upper trunk and branches almost of a cinnamon yellow, is, in many places, the most abundant forest tree, but does not extend further north than lat. 62½°. The Siberiak is, however, proudest of his cedar, a tree very similar in appearance to the Scotch fir, but more regular in its growth, clothed with branches nearer to the ground, and with an almost uniform grey trunk. The wood is dark, but not so dark as larch, and there is very little of the white inferior wood next the bark. If stacked too long in the forest, it is liable to be attacked by the worm, but for furniture and indoor work it is considered to be the best timber in Siberia. It is said never to rot, or shrink, or warp, or crack. It is soft and easy to work, but has, nevertheless, a fine grain, and is almost free from knots. The Ost-yaks use it for building their ships. They take a trunk two or three feet in diameter, split it, and of each half make a wide, thin board. The rest is wasted. Such an extravagant tool is the axe! The Russian peasant is still more prodigal with his timber. It is by no means an uncommon thing to see magnificent cedars cut down, merely to be stripped of their cones, to provide the peasant with a sackful of his favourite cedar-nuts. I noticed this tree up to lat. 67½°. The birch is common up to lat. 69½°, and in various places I noticed that, where a pine-forest had been burnt or cut down, it appeared to be immediately replaced by a luxuriant growth of birch. The creeping birch and two or three sorts of willow are common in suitable localities on the "tundra" as far north as we went, *i.e.*, lat. 71½°, The alder was abundant at 69°½, and the juniper at 69°. I did not observe the poplar further north than lat. 66°. The Ost-yaks hollow their canoes from the trunks of this tree.

The winter quarters chosen by Captain Wiggins were very picturesque. Standing at the door of the peasant's house, on the brow of the hill, we looked down on to the "crow's nest" of the *Thames*. To the left, the Koo-ray-i-ka, a mile wide, stretched away some four or five miles, until a sudden bend concealed it from view; whilst, to the right, the eye wandered across the snow-fields of the Yen-e-say, and, by the help of a binocular, the little village of Koo-ray-i-ka might be discerned, about four miles off, on the opposite bank of the great river. The land was undulating rather than hilly, and everywhere covered with forest, the trees reaching frequently two, and, in some rare instances, three feet in diameter. The depth of the snow varied from four to six feet; and travelling without snow-shoes, except on the hard-trodden roads, was, of course, utterly impossible. I generally made two rounds a day through the forest, and soon exhausted the ornithology of the district. During the first week I succeeded in identifying 12 species of birds. For the next four weeks I only increased my list by a weekly average of three species. June is the month in which nearly all migratory birds arrive in the Arctic circle. In the three weeks between the 29th of May and the 18th of June I added 65 birds to my list, and afterwards only occasionally picked up a new bird which had escaped my notice.

We had six feet of snow on the ground, and wintry weather until the first of June. Summer then suddenly set in. Innumerable migratory birds arrived. The snow melted. The ice broke up at the rate of a hundred miles a day. Icebergs of gigantic size came down the river at an incredible speed. The scene was the grandest convulsion of Nature that it has ever been my lot to witness. In fourteen days the river rose seventy feet perpendicularly in height, and the good ship, the *Thames*, was wrecked in the ice. Fortunately, we succeeded in running her ashore, where she was afterwards repaired. In July we started homewards; but, before we had gone two hundred miles down the river, we ran aground on a sandbank, and the river sank so rapidly that, at the end of a week, we could walk round her on dry land, where we left her, a hopeless wreck, a monument of British pluck and blunder. There are two characteristics by which an Englishman may generally be recognised—two marked features in the English national character. One of these is an unlimited capacity to blunder, the other is indomitable pluck and energy in extricating himself from the consequences. If all that the sailors told me be true, the ill-starred *Thames* was lost ten times, but the pluck and energy of the captain only succeeded in saving her nine times. We left her, on the 9th of July, in lat. 67°.

The moment that the snow disappeared vegetation sprang up as if by magic, and the birds made preparations for breeding. Although I had taken the precaution of providing myself with a ship, the misfortunes of Captain Wiggins delayed me on the Arctic circle for some weeks. As we passed through Yen-e-saisk, I bought a schooner, of a shipbuilder of the name of Boiling, a Heligolander. I christened it the *Ibis;* and, on the 29th of June, we left the Koo-ray-i-ka with this little craft in tow. As we sailed northwards in the *Ibis* the forests became smaller and smaller, and disappeared altogether about lat. 70°. The highest point we reached was lat. 71½°, where I sold the *Ibis* to the captain of a Russian schooner which had been totally wrecked during the break-up of the ice.

During this voyage we came into contact with several of the native races. The Russians call them all Asiatics. The name in general use among

the Polish exiles, with whom I was able to converse in German, was "die Wilden."

The most northerly race is that of the Sam-o-yades. They extend from the Kah-nin peninsula in Europe to the North-east Cape in Asia, occupying the land to about 300 miles from the coast, exceeding that distance at the gulfs of the Obb and the Taz, the whole of the shores of which they are said to frequent.

The Yu-raks are not a numerous race, and occupy the district between the east shore of the gulf of the Taz and the Yen-e-say, from the Arctic circle, to about 70° N. lat. They seem to me to be very nearly allied to the Sam-o-yades, especially to the Sam-o-yades of the Pet-chor-a.

The Ost-yaks are distributed immediately south of the Yu-raks, from the Arctic circle to the Pod-kah-min-a Tun-goosk. They seem, also, to be very nearly allied to the two preceding races, and to speak a dialect of Sam-o-yade, and must not be confounded with the Ost-yaks of the Obb, who are said to be a Finnish race.

The Dol-gahn territory is bounded on the north by the Sam-o-yade land, about 70° N. lat., on the south by the Arctic circle, and on the west by the Yen e-say, from which river it extends eastward 300 or 400 miles. These people are of quite a distinct race. Instead of being sallow-complexioned, like the races previously mentioned, they are more copper-coloured, and, if we may judge by the taste they display in ornamenting their dresses with beads, more civilised. From their language, and especially their numerals, we may infer their close relationship to the Tatars of Western Siberia and Eastern Russia, and also to the Turks. They must, however, have separated from these nations before the latter became Muhammadan. They are said to possess calendars, made of wood or mammoth ivory, hexagonal, and tapering slightly from the centre to each end. On these the days and months are marked, with signs for the Russian holydays. There are other signs upon them, said not to be Russian, but to resemble Runic characters. Their nearest relations are said to be the Yah-kuts, a race which we did not meet with, but who, we were told, occupy the district watered by the Kat-an-gar river irom 70° to 73° N. lat. Whether these Yah-kuts are of the same race as those inhabiting the valley of the Lay-na (Lena), I am unable to say.

The Tun-goosks occupy the districts on the east bank of the Yen-e-say, drained by the Nizh-ni Tun-goosk and the Pod-kah-min-a Tun-goosk. They are also a copper-coloured race, but of a very low type of feature. I was told that their language is also nearly allied to that of the Dol-ghan. If this information is correct, they are probably a different race to the Tun-goosks of the Lay-na.

The Siberian "tundra" is something like the fjelds of Lappland, something like a Scotch moor or an Irish bog. It is a wild undulating extent of country, full of rivers, lakes, and swamps, stony, but not rocky, gay with brilliant wild flowers, abounding with ground fruits, such as crowberry, cranberry, cloudberry and Arctic strawberry, and swarming with clouds of mosquitoes. The hill tops are barren and stony, but the valleys shelter dwarf willows and stunted birch.

These "tundras" are evidently rising gradually. Ancient drift-wood, rotted into tinder, is often found above the present limit of the highest floods, and at Gol-cheek-a I found large heaps of recent sea-shells, at least four miles from the river-bank, and 500 feet above the level of the sea. At Doo-din-ka I saw excellent coal and copper ore, the latter said to analyse from 5 to 10 per cent. of copper, which had been brought down in considerable quantity from the "tundra." The river abounds in fish—sturgeon, sterlet, nyelma, or white salmon, and other excellent kinds; and at Gol-cheek-a we saw hundreds of *beluga*, or white whale.

On the 23rd of July, I left Gol-cheek-a in the last Russian steamer up the river, and reached Yen-e-saisk on the 14th of August. After a few days' delay, I drove across country to Tomsk, stopping a day or two in Kras-no-yarsk. In Tomsk I found an excellent iron steamer, in which I sailed down the River Tom into the Obb, down which we steamed to its junction with the Eer-tish, up which we proceeded until we entered the Tob-ol, and afterwards steamed up the Too-ra to Tyu-main, a distance by water of 2,200 miles. From Tyu-main I drove through Ekatereenburg across the Urals to Perm, where I took my passage on board the *Sam-o-lot*, or self-flyer, down the Kama, and up the Volga, to Nishni-Novgorod. In St. Petersburg I spent a week, and reached London on the 9th of October, bringing with me more than a thousand skins of birds, about five hundred eggs, and a cart-load of native costumes and other ethnological curiosities. I everywhere met with the greatest kindness and courtesy, and am very much indebted to friends, too numerous to mention, who assisted me in many ways during my adventurous journey of more than 15,000 miles.

The success of Captain Wiggins in reaching the Yen-e-say in 1876 encouraged two steamers to come out in the following year. The *Louise* succeeded in reaching Tobolsk, where she wintered. The *Frazer* reached Volcheeka, on the Yen-e-say, where a cargo of wheat ought to have met her; but, in consequence of the cowardice, or the blunders—not to say the dishonesty—of the persons in charge, it never arrived, and the steamer was forced to return empty. Notwithstanding his misfortunes, Captain Wiggins stuck bravely to his enterprise, and 1878 saw him again in the Obb with a steamer, *The Warkworth*, drawing 12 feet of water. The navigation of the lagoon of the Obb is attended with considerable difficulty. A cargo of wheat awaited him at Sin-secha, 40 miles beyond Na-deem, a port on the south-east of the gulf, but he was unable to reach it for want of water. While he was searching for a channel amongst the mosquitoes, a cold north wind set in, banished every sign of a mosquitoe, backed up the waters of the Obb, and enabled him to cross the bar. Within sight of the praam, it was disappointing not to be able to get near enough to load. If the mountain would not come to Mahomet, Mahomet must go to the mountain. There was no help for it, the praam, probably three or four hundred feet long, only pegged together, with ribs fearfully wide asunder, and with a captain chicken-hearted—as Russian sailors alone can be—was obliged to trust itself to the swelling waves. Though the poor praam writhed like a sea-serpent by the side of the

steamer, the operation proved successful, and Captain Wiggins turned his face homewards with the wheat on board. The cream of the success was, however, skimmed at the bar. Two hundred tons had to be thrown overboard before the deep channel could be reached, but Captain Wiggins succeeded in bringing the bulk of the cargo safe into London.

Last year was, fortunately, a bad year for the Kara Sea; otherwise, the unlimited capacity of the British merchant to blunder would have damned the Kara Sea route with well-merited disaster. In spite of the difficulties with which Captain Wiggins had to contend, British merchants were found who actually chartered vessels for Na-deem drawing fourteen to seventeen feet of water. Yet we hope, for the credit of their commercial honesty, that the insurance companies did not share their unlimited capacity to blunder. Fortunately these steamers never entered the Kara Sea. Long continued east winds drove the remnants of the Kara Sea ice against the shores of Nova Yembla, and a narrow belt of pack ice, which the steamers dare not face, blocked the Kara gates. It was afterwards ascertained by Captain Markham that a similar belt closed the Ma-tosh-kin Scar. The steamers waited some time, and, fortunately for them, retured home. They manage things better in Germany. The steamer from Bremen waited till the Kara gates were open, took in a load of wheat at Nadeem, and returned in safety. The rest of the wheat was taken back to Tobolsk.

I have no doubt whatever that an extensive trade will some day be carried on between this country and Siberia, *via* the Kara Sea, in the unlimited produce of South Siberia, which can so easily be floated down the Yen-e-say and the Obb to some port which may be selected near the mouths of one of those rivers. To attempt to take a steamer to one of these rivers on speculation, with the chance of picking up a cargo, is simply throwing away money. The duration of open way in the Kara Sea is too short to admit of the ascent of either river to any town where a cargo can be obtained. The appearance of any vessel at such towns would raise the value of produce to famine prices, and the navigation of the rivers is too dangerous for ships drawing depth of water sufficient to be seaworthy.

A responsible agent must reside in the country; for the Yen-e-say at Yen-e-saisk, the emporium of the gold-mining district, and for the Obb at Tyu-main, within easy reach of the great fair at Eer-beet (Irbyt); and he must himself accompany the cargo down to the port, where storehouses must be built for the safe wintering of any cargo that the steamers are obliged to leave behind.

The most important article of commerce will, undoubtedly, be wheat. The great steppe which lies between the Tobol and the Obb, a thousand miles across, is capable of producing an unlimited supply of wheat of excellent quality, which makes delicious white bread. A common price on the banks of the river is 25 kopeks per pood, or 6d. per 40 lbs. English. Oats, barley, and rye are also extensively grown. An idea of the cheapness of hay and corn in this district may be gathered from the fact that, for a thousand miles, we paid for the hire of our horses at the rate of a halfpenny a horse a mile. Linseed, flax, hemp, hides, tallow, wool, and many other products, are equally cheap. The iron mines in the Ekateimeburg district have a world-wide fame. I picked up a piece of the ore from one of the heaps, and found it so rich and highly magnetic that a large needle could be suspended from it. Thousands of tons of this iron have been carried across the Ural mountains, to be made into the finest qualities of cast steel in Sheffield, where it has a reputation only inferior to that of iron made from the celebrated Dannemora ores. There are copper mines both in the valleys of the Obb and Yen-e-say. The gold mines north-east of Yen-e-saisk are of great importance. I was told that there are ten or a dozen mines, each producing from five to seven tons of gold per annum. It is scarcely probable that a lucrative trade can be carried on in timber until the forests of the Mezen and the Petchora are exhausted. The principal Arctic produce is mammoth ivory and furs, ermine, sable, squirrel, black, red, white, and blue fox, bear, otter, glutton, lynx, &c. Further south, elk is found in great abundance. In a warehouse in Yen-e-saisk I saw more than a thousand skins of this fine animal, which is hunted in the snow.

Probably, the Obb will prove the best of the two great rivers for commercial purposes. If the much-talked-of canal across the Yat-mal peninsular into the By-der-at-skerry Gulf could be formed, it might prove almost as important as that across the Isthmus of Suez.

The present port of Gol-cheek-a, on the Yen-e-say, is entirely unsuitable. The sand banks at the mouth of the little river of Gol-cheek-a increase every year, and this harbour will probably soon have to be deserted. No ship drawing more than five feet of water ought to venture there, and then only with great care, for the channel is a very tortuous one, and continually becoming shallower. A colossal fortune awaits the adventurer who is backed by sufficient capital and a properly organised staff to carry on a trade between this country and Siberia, *viâ* the Kara Sea, provided also that he combines British pluck with German "Grundlichkeit."

I cannot close my narrative without an allusion to the crowning feat of all this eastern Arctic enterprise. In 1878, Professor Nordenskiold sailed through the Kara Sea, past the mouths of the Obb and the Yen-e-say, round the North-east Cape, past the mouth of the Lay-na, and wintered off the coast of the Tchus-ky Land. When the ice broke up in 1879, we sailed through Behring's Straits to Japan, having, for the first time in the annals of the human race, succeeded in making the north-east passage to Cathay. This voyage may not have any commercial value, but, in a scientific point of view, it must rank as the most successful Arctic expedition ever made.

DISCUSSION.

The Chairman said Mr. Seebohm had told them, in the most charming way, how Captain Wiggins, Professor Nordenskiold, and other able pioneers, had opened up a new road for commerce, and also of a vast region yielding valuable products which might be tapped and brought within the commerce of the world. It was many years since he had listened with such pleasure to anything as he had to the description of the breaking-up of

the ice in the Yen-e-say. In discussing the paper, it should be our endeavour to aid the objects of these pioneers, by calling public attention to the various points raised. First, as to ways and means for receiving cargoes when ships were sent there, concerning which some mistakes had been made; secondly, as to the dangers and difficulties to be met with, and the mode of overcoming them; and then they might hope to hear further particulars as to the probable demand for English products. It was not at all irrelevant, therefore, that Mr. Seebohm had brought such a collection of specimens of art and manufactures, showing the love of ornament among the natives, and the things they might be likely to want. He would first call on Captain Wiggins, who had shown the way for others to reach these parts.

Mr. Swabey asked permission, first, to ask if Mr. Seebohm had ever seen the Brent-goose in his travels. He had been in northern latitudes and seen this grand breaking-up of the ice, and seen the Brent-geese still going north; and the Americans thought that by following them the Pole might be reached. He believed their eggs had never been found.

Mr. Seebohm said he had never seen a Brent-goose, only the Beam-goose, and the little white-fronted goose.

Captain Wiggins said he had been persuaded by Mr. Seebohm to attend, or he should not have been in London that evening. He felt the full importance of the subject, though he had lately almost abandoned it; not from his own wish, but by force of circumstances, which had been explained by the reader of the paper more forcibly, perhaps, than some people would like. Mr. Seebohm now seemed to think that he had made rather a blunder in ascending the Yen-e-say with the *Thames*. They succeeded in ascending the Koo-ray-i-ka considerably further than Nordenskiold went with his steamer, and it was clear now they should not have done so had he known how easy it was for vessels to descend the Yen-e-say or the Obb, to the estuaries of those grand rivers. But he did not anticipate such grand results; and being an explorer, he was, of course, ignorant, and did not know how best to act. Anybody who could make perfect arrangements for going to an unknown land, and go straight to the Pole, or anywhere else, either with balloons, with ships, sledges, or any other means, must be endowed with something more than human intelligence. And not only had he managed to blunder, but many others had done the same. It was a proof of blundering on the part of Nordenskiold, that he wanted to take his steamer up the Yen-e-say; his intention was to return to Karyoposki, but he could not find a channel; still it was better for him in the end, as it saved him the expense and annoyance of having to winter in the river. It might be thought another blunder that he (Capt. Wiggins) lost his vessel in the spring, but he valued that as nothing compared with the fact that he had proved that vessels could go up the Koo-ray-i-ka. Now, however, it appeared that vessels need not go up there, as vessels came down those rivers from the interior every year. Some one might ask how was it that their fine vessels, properly protected against the ice, should be lost, when these river steamers could ply year after year without danger. But the answer was very simple. These vessels went up to Yen-e-saisk and Tyu-main, where the river was much smaller, and got into little creeks, and the immense rise in the river did not take place there. As soon as the ice passed away, the steamers, which were already loaded, followed it down in perfect safety, with a clear river, as far as Gol-cheek-a; and they ascended again in the autumn, after the heavy currents had passed away, against a current of not more than a knot, arriving as late as November 15th. He arrived at Koo-ray-i-ka as late in the season as October 9th, showing that these regions did not freeze so early as was supposed; many people thought these rivers were impassable in October, but that was a great mistake. One of the greatest blunders made by our merchants last year was in having totally unsuitable vessels, not only drawing 17 to 18 feet of water, but also unprepared for ice navigation, common North Sea coast steamers in fact. The *Warkworth*, which he took out, was only an ordinary steamer, but he took it under peculiar circumstances, and almost under protest. A friend of his, Mr. Kabli, of St. Petersburg, one of the best men he had ever met, on the strength of his word alone, went to Tobolsk and other places, and bought about a thousand tons of wheat in January and February, came home, and requested him to send a steamer for the cargo. He told him there was not time to build a steamer, or get one properly fitted; but Mr. Kabli said he must get one, or the cargo would be wasted, and, under those circumstances, he got the best he could. An ice steamer ought to be like a whaler or a Hudson's Bay vessel—wooden built, thoroughly strengthened with very thick plates outside, and plated with iron, especially at the bow. The propeller ought to hoist up, so that it could be replaced if broken; the rudder should ship and unship with ease, and spare rudders should be on board. Besides this, the ship should be thoroughly rigged, so that, in case of an accident to the shaft or machinery, she could sail home under canvass. The gentleman who undertook last year's work did not see the necessity of going to all this expense, and thought he (Capt. Wiggins) was exaggerating the difficulties. The *Warkworth* was not so well prepared as that, but he took a good supply of rigging and sails, provisioned her for 12 months, and took plenty of furs—in fact, made every provision for an accident, so that, if they had to abandon the ship, at least the lives of the crew might be saved. Because he succeeded once, the merchants thought the same thing could be done every year with the same class of vessel. He protested against it, and tried to persuade the owners to break the charter, fearing there would be a disaster, but in vain. The merchants wanted him to go, but did not see their way to give him the exorbitant terms he asked, which was about £100 for each vessel, or to adopt his views with regard to the equipment. He had surveyed these districts at a considerable cost of time, money, and risk, and had his own charts and maps, which he, on his part, did not see his way to give them, and the result was they actually went without charts for the sake of a paltry £500. The greatest curiosity was they found men to go, and that the Board of Trade protected them; for he appealed to the Board whether it was right to risk the lives of some hundred men in this way. However, they were allowed to go, and as Mr. Seebohm had told them, fortunately the ice blocked the straits, and they could not get into the Kara Sea at all, so that they never experienced the difficulties of the voyage. The audience might suppose that the same thing would prevent the success of future expeditions; but that was not so. If the right ships were used, the ice would no more prevent their progress than the sea-weed in the Saragossa Sea. A sailing vessel, if she got into that, would lie for ever if she were becalmed, but it was nothing to a steamer; and a Hudson's Bay steamer could pass through these straits with the greatest ease in less than four or five hours. The only ice there was that continually brought down by the current, and a northerly wind setting in blocked the straits with loose drift ice; but a properly adapted vessel would soon get through it. He had surveyed the whole of the By-der-at-skerry Gulf, in the hope that they might have a railway across there or a canal, which Mr. Seebohm did not approve of. He quite agreed that, if a canal were made and it was still water, it would probably freeze and never melt; but his only hope of the canal succeeding was that the River Obb might be higher than the Kara Sea, and that, if

well cut through, there might be a scour and a constant current which would keep the channel clear, as, he believed, it existed many thousand years ago, before it had gradually silted up. Mr. Seebohm advocated a longer railway, across to the other gulf; but he did not approve of that, because that gulf was frequently blocked with ice, and was not a suitable place for ships to come to. The line proposed had been thoroughly worked out and surveyed by the Russians, and the Russian Government, who had thought seriously of it in connection with the Pet-chor-a River. Sideroff, who was really an extraordinary man, had spent a large fortune over that river, having a monopoly of it from the Russian Government, but he made a great mistake in sending big steamers there, which were lost by the dozen, some eight or ten years ago. His idea was to connect it by overland transit with the Obb and the Yen-e-say, and to ultimately get the monopoly of those rivers also. He had tried to advance his own scheme by purchasing the little vessel of Mr. Seebohm, and brought her round successfully to St. Petersburgh. And here it might be asked how it was that the Englishmen who owned her did not bring her round themselves? The truth was the crew were so alarmed by what they saw that they refused to return home in that little vessel. He did everything he could except force them; offered them rewards, and told them their honour was at stake, but their only answer was, "Life before honour, Sir." After talking to them an hour in the cabin, Mr. Seebohm walked out disgusted. He (Capt. Wiggins) would have brought her home himself if he could, but that was impossible, and therefore they were obliged to sell her to the Russians. He offered them his share of her for nothing, if they would let him accompany them, but they said, "No; it is a Russian expedition, and if we buy the ship no one must go in her but Russians." He could only say, "You are a first-rate lot, and you deserve all the success you may get." To come back to the railway, the passes had been examined in all directions, and very fair passes for sledges had been found. Sideroff, who had a plumbago mine on the Koo-ray-i-ka, had actually brought a cargo all the way to Archangel by this route with reindeer, and delivered it at St. Petersburg; his hope being that by showing the practicability of the route, the Government would give him a monopoly of these rivers. He brought about 20 tons of very good graphite, but the expense of transit was too great to make it pay. A great part of the cargo of the *Thames* was pure graphite, taken from the banks of the Koo-ray-i-ka, simply with a crowbar and pickaxe, not the best, because it was on the surface, and no doubt it would have been found better a little deeper, probably equal to the best Cumberland lead; on the top of that he had tallow, samples of wheat, and many other things. With regard to the gold mines on these rivers, he might mention that Sidorikoff, a wealthy gold-miner, who subscribed £1,000 when he went out in the *Thames*, himself, in three months, sent seven tons of gold to the bank in St. Petersburg. He was one of Nordenskiold's greatest supporters, having given him £3,000 on one occasion, and found the greatest part of the money for him to go round to Behring's Straits; in fact, he was a true patriot. With regard to the kindness they experienced on all sides, he could fully confirm every word Mr. Seebohm had said, and, perhaps, even go beyond him, because he went there first almost unknown, yet he received the greatest kindness and assistance from the poor exiles at Gol-cheek-a, and even from the natives. On one occasion, when he was in difficulties about making his way, some natives came alongside, and an old gentleman came on board who walked the deck like a prince. He seemed to know exactly what was wanted, guided him up between the islands as far as he could, and then landed and got more help from others, and so brought him to Dudin-ka. He afterwards found that he had been piloted by the King of the Samoides, and was sorry he had only given him a bed in the forecastle with the sailors. When the king was offered a present, he refused t take anything, though he said if he had not been serving him he should have been very glad to have taken one, but he could not take anything for his services. The only thing he (Capt. Wiggins) could do, therefore, was to wait till next year, when he made him a present. It was a great assistance in travelling to have letters of introduction, because by means of them you were furnished with a *padorijina* which conferred on you the privilege of royal couriers, and entitled you to horses at every village, no matter at what expense, and if one dropped on the road, another would be taken from the first caravan or vehicle that was met with without a word. In this way he had done upwards of 250 miles in 24 hours, continuously, day after day. At Tobolsk, the Governor, who was related by marriage to the Imperial family, insisted on his dining with him, and he found there an English governess, who told him she had lived there for some years in the greatest happiness, being always treated as one of the family. The only other point he need refer to was Nordenskiold's grand voyage. In 1875, Nordenskiold made up his mind to try that route, and he (Capt. Wiggins) said then it was the best route to Behring's Straits, and he believed it would be found the best route to the Pole. At that time, the Smith's Sound expedition was in vogue, and it was no use for him—who was not then any authority—saying anything, though he threw out a hint wherever he thought it would be useful. What led to Nordenskiold's success was that his country believed in him, and his Government supported him. He had won the prize, and England had lost it; but on his arrival in England he hoped he would receive a warm and princely reception. He would not remain idle in future either. He talked of going down to the Lena, and amusing himself amongst the islands at the mouth, where large quantities of mammoth ivory was believed to exist; but his real object, he believed, was to try and reach the Pole; and very probably he would do so, while England was hammering away at the Greenland, Spitzbergen, and other routes. In this matter, as in all others, they ought to follow nature; and it was useless to attempt to force your way to the Pole against cold currents coming down from it; the only way was to go with the current of one of these large rivers flowing down from tropical countries. In reply to the Chairman's question what these countries required from England, he would say everything—from the simplest thing, such as needles and buttons, up to the greatest luxuries. There were many wealthy men there; and in the large towns, no one was allowed to be mayor unless he were a millionaire (that is in roubles.) They were only waiting for us to provide the sea transit, and they would do all the rest. He had not much hopes of doing anything this year, as the blunders and failures of last year had discouraged people; but if a company were formed, or if any private individual would undertake the work properly, he would willingly give his services free, and all his charts and surveys, but he would not assist in any unsuitable expedition.

The Rev. Mr. Lansdell said he had lately been through Siberia, not for trade purposes, but having been interested for some years with the condition of prisons, he was anxious to see those of Siberia. He followed much the same track as had been described, as far as Tobolsk, only he went by the Obb, and then eastward as far as the Amoor and on to the Pacific, where he crossed to America, and so round the world. He might mention a few facts with regard to the price of provisions. On the Obb the price of ducks was 1¼d., a bottle of milk 2½d.; a calf could be bought in some villages for 6d. From Tomsk he made a detour to Barnoul, where he found splendid black land which could be hired for about 3½d. an acre; beef sold in winter

for about ½d. per lb., in summer it was as much as 1d., and veal 1½d.; birds similar to grouse, when dear, were 3d. a pair. On the other hand European goods were dear. He could not get accustomed to the black bread, and thinking a pot of marmalade would be a good corrective, he found in Tomsk the price was 4s. He quite endorsed what Captain Wiggins said about the demand for English goods. A few cases of needles made admirable presents, and produced much good feeling. He could go on talking about the kindness he met with until midnight, but one instance would suffice. Having some trouble with the wheel of an equipage which he had borrowed, and finding the charges of the nearest wheelwright very exorbitant, he sent his servant and interpreter to a merchant in the next village, of whom he had been told, to ask him who was a reasonable man to employ. This house was reached at 4 o'clock in the morning, but on being told that an Englishman travelling wanted his assistance, the merchant got up immediately, sent one servant for a wheelwright, made another get breakfast, and would not let them go until everything was in order. He questioned very much whether a Russian disturbing an Englishman at such an hour would have met with a better reception. There was an immense opening for trade and commerce on the Amoor, and in the whole district surrounding it. White bread was much dearer there than at Tobolsk, but the rye was not much higher. With the opening of a railway in that direction, much might be done.

The Chairman said, if it had not been past the hour for closing, he should have liked to say a few words on the question of reaching the North Pole; but, perhaps, another opportunity would arise when they had Prof. Nordenskiold amongst them, which, he hoped, would be this month or next. He would only say that his views on this subject and those of Prof. Nordenskiold, with whom he was in frequent communication, were identical. He begged to propose a vote of thanks to Mr. Seebohm for his most interesting lecture.

The vote of thanks was passed unanimously.

MISCELLANEOUS.

CATALOGUE OF SPECIMENS OF THE WILD SILKS OF INDIA.

By Thomas Wardle.

[The following memorandum, originally addressed to the President of the Chamber of Commerce at Lyons, has been sent to the Society of Arts by the Secretary of State for India, with the suggestion that it should be printed in the *Journal*. Mr. Wardle has been so good as to add some further particulars for this purpose.]

A request was made to Sir P. Cunliffe Owen, C.B., last year, by several members of your Chamber, that it was desirable the Chamber should possess as much information as possible of the wild silk producing worms of India, and M. N. Rondot, president of the Silk Jury, Class 34, also thought it extremely desirable that I should furnish, and send to your Chamber such a collection, and frequently spoke to me on the subject whilst I was at Paris, last year, as supplementary juror in the same class.

By permission, and at the wish of the Government of India, I have arranged the best set of specimens I could obtain and prepare to illustrate this important subject.

For easier reference, I have numbered the specimens according to the numbers in the monograph I wrote last year descriptive of the collection I arranged in the Paris Exhibition (Indian Section), a copy of which I ask the Chamber to do me the honour to accept. It will explain most of the specimens now sent; the rest I will describe in this catalogue as they occur in order of numbering with the others.

1. Eggs of Tusser moth. (See p. 4, "Monographie du Tussore et d'autres Soies Sauvages de l'Inde.")

1A. Drawing of Tusser caterpillar, natural size and colour.

2. Cocoons showing pupæ.

3. Tusser cocoons with pedicles, showing mode of attachment to branches of trees. The pedicles are very thick and hard, consisting of silky matter.

4. Tusser cocoons, from which the moths have emerged. The aperture of emergence is well seen at the end of each cocoon.

5. Tusser cocoons, larger size, from Sambulpur in the Central Provinces. There is a striking peculiarity about the fibre of Tusser silk. I have carefully and thoroughly examined it under the microscope, and find that the fibre is flat, and not round like mulberry silks. There is no doubt that it is to this property that Tusser silks owes its glassy and vitreous look, reflecting a little glare of light from the angle of incidence on its flat surface, whilst the mulberry silk, being round, reflects the light equally in all directions. By some, this property is considered a drawback, but by the time the fibre has become modified and the flatness diffused in the loom, I think the lustre of the cloth is enhanced by it. The fibres, like all other silk fibres, are laid in the cocoon by the silkworm in pairs, united by their edges and not by their flat surfaces.

6. Tusser moths, *Antheræa paphia*, males.

7. ,, ,, ,, ,, females. The lower and smaller pair emerged in my house last June, from cocoons sent to me from Poona by my friend Major Coussmaker, of the Revenue Survey. He is taking a large and practical interest at Poona in encouraging the breeding of Tusser worms, and has written several papers on the subject.

The Tusser silkworm is found over nearly the whole of India. It is utilised, according to Mr. Geoghegan, in many parts of the Central Provinces. Gumbulpore is said to yield 3,500 seers (7,000 lbs.) of the silk; Raipori, 6,000 seers (7,000 lbs.); Bilaspore, 900 seers (1,800 lbs.); and Chanda, 22,500 seers (45,000 lbs.). The silk is woven and used in the provinces in mixed fabrics of cotton woof and Tusser weft, and in some districts fabrics are made of pure Tusser silk. The name "Tusser" is attributed by Mr. Geoghegan to the Hindustani "tusuru," which means a "shuttle," and probably the silk owes its name to the fact of its being used as weft or shuttle silk in fabrics of which the warp, as stated above, consists of cotton.

8. Tusser organzine } Native reeled, English thrown.
9. ,, tram }

9A. Tusser tram, bleached by means of binoxide of barium; ready to be dyed.

10, 11, and 12. Dyed specimens of ordinary Tusser silk. I should have sent a larger set of specimens to illustrate the recent and surprising developments in dyeing Tusser silk, were it not for the fact that my esteemed friend, M. Marnas, of Lyons, member of your Chamber, has lately accomplished as much in the improvement of Tusser silk dyeing as myself. His dyes, as shown in the Paris Exhibition, left nothing to be desired, and I leave to him, if he will kindly do so, to enrich the collection with more dyed specimens.

13. Native reeled Tusser raw silk.

14. ,, ,, ,,

17A. Tusser raw silk reeled by myself in Italy, showing susceptible improvement. (See my paper on "The Wild Silks of India," in *Journal*, Vol. xxvii., p. 499.)

17B. Tusser raw silk, the produce of a single cocoon.

yielding a length of 1,200 metres, and weighing 1,126 grammes.

18. Not sent; it is the same as 8 and 9.

19A. Gentleman's necktie made of Tusser silk.

19B. Gentleman's necktie made partly of Tusser silk and partly of mulberry silk.

20. The improved organzine and tram dyed. I have not sent a greater variety of colours for the same reason I stated under Nos. 10, 11, and 12.

21. India woven Tusser cloth, printed by me on dyed grounds, with ancient Indian blocks of native design and workmanship.

21A. Ditto.

21B. India woven Tusser cloth, printed by me on bleached grounds, with ancient Indian blocks of native design and workmanship.

21C. Ditto, unbleached grounds.

21D. Ditto, gold and silver effects.

21E. Ditto, Indian and Persian designs on black grounds.

21F. Palampore, printed by me, for my lecture illustration, with ancient Indian blocks, sent to me by the India Museum. The design is not homogeneous. The blocks are but fragments of whole designs, and some of the colours had to be applied by hand, for want of perfect sets of blocks. None of the colours I used are derived from aniline, but of Indian growth. Much brighter colours may be obtained on Tusser, but I have avoided using them, preferring the more subdued and native artistic tones, those peculiar to aniline dyes, and also to exhibit more permanent colours.

21G. A few tones of colour printed on bleached Tusser cloth. Several of these are aniline colours. As far as I have been able to ascertain, Tusser silk has never been successfully and marketably printed upon, either in India or Europe, until the results of my developments were exhibited at the Paris Exhibition last year. Since that time, Tusser printed silks have been largely printed, and worn both in France and in England, printed pompadours on Tusser having been very fashionable this year.

24. Male and female moths of *Attacus cynthia* and cocoons.

24A. Male and female moths of *Attacus ricini*, or Eria worm, and cocoons. (See "Monographie," pp. 7, 8, and the paper on "The Wild Silks of India.") The natives of India use Eria silk for the manufacture of garments, having the following names:—Borkapor, Meklas (petticoats), Rhiha (scarves), Goursha.

25. Eria silk, *Attacus ricini*, native hand spun (not cocoon reeled).

25A. Eria silk cloth, native woven.

25B. Eria silk cloth, native dyed. This silk takes dye splendidly, particularly aniline dyes. I would beg to direct attention to the fineness of the fibre of this silk (see table of comparative thicknesses of the ultimate fibres of different kinds of silk at page 13 of my monograph); also the shape of this and other silk fibres, as shown in the sheet of microscopic diagrams added to the reprint of my paper on "The Wild Silks of India."

The Government of India have, at my request, ordered a collection of Eria cocoons, to assist me in developing the utilisation of this silk by spinning. I have no doubt of ultimate success, for I consider Eria silk scarcely inferior to mulberry silk waste for spinning purposes. The garments made from it in India are wonderfully desirable. It has not, at present, been successfully reeled from the cocoon. It possesses much lustre and is soft.

25C. A specimen of native made Eria cloth, printed. I find this silk very well adapted for printing upon, and if quantities of it could be cultivated or collected, there would be an enormous development of it for all decorative purposes from dress to furniture silks.

25D. Hank of native-made Eria silk bleached with peroxide of hydrogen.

25E. „ „ „ „ „ dyed unbleached.

26, 27, 28. Other Eria silks. I am unable to send any. The Eria worm occurs in Bengal (the Dinagepur and Rungpur districts) and in Assam. In the latter province it spins a white silk, while in Dinagepur the colour of the cocoon, it is understood, is brown.

29. Male and female moths of *Attacus atlas*.

30. Cocoons of *Attacus atlas*.

The image of this species is the largest of all silk moths, being called in France "le géant des papillons." The silk of *Attacus atlas*, as well as the Eria, seems well adapted for carding and spinning purposes. The *Attacus atlas* is said to feed on the following plants, in addition to those already mentioned in my paper on "The Wild Silks of India":—1. Phakeera (*Cinchonaceae*). 2. No name, probably a laurel, foliage redolent of prussic acid; fruit like a plump kernel containing a large proportion of oil, resembling that of bitter almonds; stature large, not very common. 3. A tree resembling the China tea plant, of frequent occurrence as a weed in tea-gardens; stature middling, common in jhum lands, less so in primitive forests. 4. Nagdana (*Artimisia sp.?*). 5. Monphul (*Cachar* name), known in Lacca as the *Myna kata*. 6. Balos, a weed fed on also by the *Attacus canningi*. Hoorkooree, one of the commonest of jhum weeds, one of the most eligible for training the *Atlas* worm. 8. Lutki (*Osbeckia*), a very small plant, but the silk of it is very white. 9. Bon chelita, a large, hardy, rapidly growing tree, sufficiently common for the purposes of silk cultivation. 10. Kadam (*Nauclea*). 11. Cholita (*Dillenia speciosa*), eminently adapted for training the *Atlas* worm. 12. Boidraj (*Padrelacae?*). The silk off this is very dark. 13. Lood, also fed upon by *Attacus canningi*.

31. Male and female moths of *Actias selene*.

32. Cocoons of *Actias selene*. The silk of this beautiful insect also appears to be useful to the spinner if it could be obtained in quantity. The worm feeds on the Munsooree (*Coriaria nipalensis*), and also on the wild cherry and walnut.

33. Male moth, *Antheræa yama-mai*. This moth, although a native of Japan, has been introduced into India, and I am informed is found to thrive there.

34A. Interesting specimens of Yama-mai raw silk from Japan, kindly given to this collection by the Lords of the Committee of Council on Education. I am recommending the Government of India to encourage the acclimatisation of this species in India, as I feel certain it yields a most useful species of silk, and although a coarser fibre than that of the *Bombyx mori*, it is finer than that of the *Antheræa yaphia*, and it has a very glossy appearance. Owing to the want of sufficient quantity, I have not been able to test its dyeing capabilities, but I have no doubt that it can be dyed with moderate facility in all colours, though it may not yield so complete a whiteness as China silk.

34B. A piece of Japanese woven Yama-mai silk. The Japanese had some very interesting fabrics of this silk in last year's Paris Exhibition, as your Chamber is no doubt aware. Some of them were composed of Yama-mai silk entirely, and some of mulberry silk, ornamented with stripes of Yama-mai, undyed. A cross between the *Yama-mai* and *Bombyx Attacus pernyi* is a great success in France. It is so hardy that hatching is said to take place at freezing point.

35. Mooga or Moonga cocoons, the product of *Antheræa assama*. I am sorry I am unable to send specimens of the moths of this species.

36. Raw silk of *Antheræa assama*.

36A. Coarse tram from the same raw silk, dyed an aniline blue. This silk takes the dye splendidly, and all that is needed to secure for it an European future, is that it could be obtained in quantity.

36B. Waste silk and pierced cocoons of the same species (Mooga) for spinning. The natives of India use Muga silk for making fabrics and garments known by the following names:—Soorias (dhoties), Meklas (petticoats), Jootha Borakapor (worn in winter), Rhiha

(scarves), Chhelan (for men's shoulders), Mashris (curtains.)

37. Ya-baine silk. I am not able to send an example of this silk.

38. Mulberry Silk of Bombyx Mori. To send specimens of this silk to Lyons would be like sending "coals to Newcastle," as we say.

39. Cocoons of Pat silk, a mulberry feeding worm, *Bombyx textor*. (See my paper on "The Wild Silks of India.")

39A. Raw silk of the same species. This is a rare silkworm, and probably a variety of *Bombyx mori*.

40. A rare silk from Sibsagar, Assam, called *Mezankuri*, a Mooga silk, but fed on the mezankuri (or *Adakuri*) tree. (*Tetranthera polyantha*.)

41. See 39.

42 and 43. Dyed silks. Not sent for reasons stated under No. 10, 11, 12.

44. This is a specimen of an Eastern dye on ordinary silk, called Kamalá or Kapila, the powder brushed off the capsules of Mallotus Phillipensis. As far as I am aware, it is not used in Western Europe. I exhibited three shades of it in the Paris Exhibition, and they stood the bright light in the India Section remarkably well. (See pp. 10 and 28, Monograph).

45 to 51. A series of samples illustrating the processes in spinning the waste of Tusser silk and pierced Tusser cocoons up to the perfected thread.

These samples show to what uses the waste of Tusser silk and the cocoons pierced by the exit of the moth can be put by spinning, in the same way threads of cotton and wool are manufactured. The series commences with samples of pierced cocoons which could not be wound, and waste silk from ordinary Tusser manufacture, followed by samples showing the various processes the silk undergoes before it is made into thread or cord for weaving or for sewing purposes. This suggests forcibly a promising economy in store for the produce of all silk-making cocoons. There are many species unknown to commerce rejected because of their not being capable of being wound in the ordinary way, but now that spinning machinery is in such a perfect state, all cocoons may be spun and converted into materials of some use or other. In Simla alone, there are said to be eight or nine species of Bombyx which no doubt might be utilised in this way.

The following table is given as the life history of several of the silk-producing worms:—

Name of Silk-worm.	Period of Life of Moth.	Period from Laying of Eggs to their being Hatched.	Period of Life of Worm.	Period from Beginning of Worm to Spin to Completion of Chrysalis.	From Completion of Chrysalis to Emergence of Moth from Cocoon.
Tasar or Kutkuri	3 or 4 days.	9 days.	36 days.	15 days.	10 to 20 days.
Moonga	6 days.	10 days.	30 days.	5 or 6 days.	
Eria*					
Pat major					
Bombyx textor	3 to 4 days.	10 months.	30 to 40 days.	5 or 6 days.	20 to 25 days.
Pat minor					
Bombyx cræsi					
Attacus Atlas+					

The Pat gives only one crop of cocoons in the year. In Upper Assam the eggs of the Pat are hatched about the end of December, and in Lower Assam about the end of January.

* Not known exactly; a complete cycle is made in from 43 days to two months.

+ No exact details are given—eggs lie dormant through cold weather, and two, or perhaps three, crops, are obtained in the year.

The Eria sometimes gives as many as seven crops in the year. The Muza gives five crops a year, and the Tasar, it is believed two crops a year. Attacus Atlas gives two, or perhaps three crops.

The difference in colour of cocoons in the case of cocoons of the same silkworm is known to be due partly to local influence of climate, and largely to the food which the silkworm eats.

Of wholly domesticated worms, the common kinds in Assam are the Pat major, the Pat minor, and the Eria, or Arundy. Both these kinds of silkworms are fed within doors, the leaves of the trees and the plants they feed upon being plucked and brought to them. The Pat (*Bombyx textor*) which is closely allied to the common mulbery silkworm (*Bombyx mori*) of Europe, is more delicate, and has to be treated with more care than the Eria. The silk of the Pat is, however, more valuable. Great care has to be taken to keep everything about the Pat scrupulously clean.

53. Samples of spun Tusser threads of various kinds used in weaving, knitting, sewing, &c. The finest yarn that can be spun of this silk is 35½.

56. Series of fabrics or stuffs made from Tusser waste and pierced cocoons. These stuffs were all made by the clever and persevering firm of Messrs. Clayton, Marsdens, Holden, and Co., spinners, Halifax, Yorkshire. They have been most successful in perfecting, even to a surprising degree, this special manufacture, having succeeded in utilising and creating a demand for Tusser waste, which only a few years ago could not find buyers at 4d. per pound, and which lay about the English ports for some time quite unsaleable. (See discussion on my paper.)

56A. Cloaking or furniture stuff made of Tusser spun silk warp and cotton weft. This sample, as well as all those from 45 to 56, were made by Messrs. Clayton, Marsdens, Holden, and Co., and I have much pleasure in laying their results before the Lyons Chamber of Commerce, as having sustained and developed my efforts during my researches in finding utilities for the waste of this silk.

56B. Shawl of Tusser silk, spun.

56C. Shawl of Tusser silk, printed.

I also speak in like manner of the successful weaving of cocoon reeled Tusser of Messrs. J. Birchenough and Sons, of Macclesfield, who have made in this branch a specia effort of late years, both in broad Tusser cloth, and in the ties shown under Nos. 19A and 19B.

Messrs. Brocklehurst and Co. and a few other Macclesfield manufacturers have also recently helped to develop this industry.

Considerable quantities have also been manufactured in France by manufacturers unknown to me, and not a little has been used in both France and England during the last 18 months for the black gauffered braids, so much worn for fringe, and which have been almost as effective as mulberry silk braids. In March, 1878, there were nearly 2,000 bales of Tusser raw silk in London that could not find buyers, even at as low a price as from 2s. 3d. to 2s. 9d. per lb., whilst at the present time there is scarcely a bale to be bought in the market, and its value has risen to not less than 7s. per lb. Since that time all mulberry silks have decreased in value, whilst, strangely, this has increased so much.* I attribute this

* The following Table shows the state of the London market in Tusser silk for the last few years, and shows the remarkably increased consumption since the Paris Exhibition of last year:—

Year.	Stock, Jan. 1st.	Imported.	Consumed.
	Bales.	Bales.	Bales.
1874	662	none.	168
1875	494	none.	319
1876	175	427	174
1877	428	1,037	284
1878	1,181	837	736
1879	1,282	58	1,142
1880	194	.....	.....

remarkable change of value in Tusser silk solely to the fact of the discovery of the successful application of colour by dyeing and printing to this silk hitherto so intractable and dye resisting. The remarkably increased consumption for 1879 is as surprising as it is gratifying. I have elsewhere given prominence to the important application by M. Tessiè du Motay, of bleaching this silk, which has enabled dyers to dye it in all pale colours (see paper on "The Wild Silks of India"). Since their further developments in bleaching by the more direct application of this bleaching agent have been effected by M.M. Girard and Lebouteux, of Paris, as your Chamber is no doubt aware.

Nos. 57 to 73. Indian district silks. I am unable to send illustrations of.

74. Specimens of Tusser silk I have had prepared for embroidery use.

75. Specimens of a new style of embroidery, "Tusser sur Tusser," planned and executed by my wife. It is now receiving some attention in England. (See paper on "Wild Silks."

In addition to the accompanying monograph, descriptive of the wild silks of India, which I was induced to write at the especial request of Sir Philip Cunliffe Owen, C.B., in Paris last year, I was also asked by him to arrange a large series of dye stuffs of India, sent over to be exhibited at Paris, and to prepare a monograph catalogue of them for publication and sale in the Exhibition. This monograph will be found in the same little volume as that on the wild silks. I hope that among this prolific series of dyes, some may be found useful to the French dyers.

I am at the present time engaged in examining the tinctorial properties of those of them which are dyestuffs proper, and in estimating the amount of tannin contained in each tannin substance.

I shall shortly send in my report to the Government of India, and I have no doubt that they would gladly send a copy to your Chamber if you shold think it useful to the dyeing arts of France.

In concluding this catalogue, I have the honour to draw attention to the paper I was requested to read at the Society of Arts, in May last, in which will be found a more complete treatment of the subject.

Although I cannot presume to expect that your Chamber is not fully cognisant of most if not all the matters I have described, I am glad to draw attention to them afresh now that the Government of India is giving them all possible official local attention and encouragement to private enterprise for the industrial development of them, and particularly to that of the Tusser worm.

It will be a high pleasure to me if my efforts may prove of some use or interest to the great silk industries of France, particularly to that of your city.

I have, &c.,

Thomas Wardle.

EFFECT OF TEMPERATURE ON VEGETATION.

The *Botanische Zeitung* publishes the results of Dr. Staub's observations in various parts of Hungary, on the influence of temperature on the leafing and flowering of various trees. The flowering period is only hastened when the mean temperature for the month in question is 3°.5 Fahr. higher than the mean of several years; a smaller augmentation of the temperature does not affect vegetation. An exception to this law occurs when the temperature of the preceding month or months is above the average mean; for in such a case vegetation is under the influence of the secondary effects of temperature. The smallest fall in the average mean temperature of the month entails a corresponding retardation of the flowering period, and the retardation is all the greater the more the temperature of the preceding months has been below the average mean. Should the mean temperature of the preceding months be higher than the average, the lower temperature of one month is unable to hinder the development of vegetation. Dr. Staub finds that woody plants in their struggle with the climatal factors strive to keep within the limits of a certain flowering season to which they have become accustomed during generations. In relation to this there is a characteristic mean temperature for a certain period, say from the beginning of the month in question, preceding the appearance of the flowers. Thus, according to five years' observation at Buda Pesth, it amounts to $+11°.5$ C. for the horse chestnut, with a mean error of $\pm 1°.836$ C.

CENSUS OF 1881.

The report of the Committee of the National Association for the Promotion of Social Science on the proposed arrangements for next year's census has been adopted by the Council of the Association. The committee had before them a letter addressed by Dr. Farr, F.R.S., last June, to the Home Secretary, in which he submitted that particulars respecting "religious persuasion" and "sanitary condition" should be added to the English schedule.

The results of the committee's deliberations have been put into the following twevle resolutions:—

1. That it is essential that all the particulars given in the census, for each part of the United Kingdom, 1871, be repeated in the census, 1881, with such (if any) amendments in detail as may be found desirable.

2. That it is desirable that, as far as practicable, the census for each part of the United Kingdom contain similar information, and be the same in form.

3. That it is desirable that in the census of England and Scotland, as in the census of Ireland in 1871, the religious profession of each inhabitant be ascertained, and that this inquiry form part of the householder's schedule.

4. That it is desirable that in the householder's schedule there be a column for "sickness" or "injury" in the following form:—Sickness or injury.—Sick to include all who require medical advice or who are disabled from following their usual employment. Write the name of disease from which the patient is suffering.

5. That it is desirable that a return of the number of rooms in each house be given in the census of England and Wales, and in that of Ireland, as has already been done in the census of Scotland.

6. That it is desirable that houses be distingnished between those intended for habitation and those not intended for this purpose.

7. That it is desirable that there be a return of houses intended for habitation which are unlet.

8. That it is desirable that the returns under the head of occupation be amended in order to show the nature of the employment with greater precision.

9. That it is desirable that for every city and town the concentrated population, and the area which it occupies, should be returned, whether its boundaries be coincident or not with any legally defined boundary or boundaries.

10. That it is desirable in the case of towns and other areas of concentrated population, that summaries of the returns should be made up and recorded for each enumerator's district and be open for inspection at the offices of the Superintendent Registrar.

11. That it is desirable that the census be quinquennial, instead of decennial as now, each census to be complete and to contain full particulars.

12. That a representation be made to the Government, praying that effect be given to the above resolutions when the census is taken in future years.

NEW ZEALAND FLAX IN ORKNEY.

Dr. W. Traill gives the following results of an attempt to introduce the *Phormium tenax* into the Orkney Islands in a paper read before the Botanical Society of Edinburgh last December. These islands, from their high latitude—59° north—enjoy comparatively little heat in summer, though their winters are remarkably mild, there being little snow and frost, which is, perhaps, partly attributable to their insular position, but is chiefly caused by the action of the Gulf Stream, which makes its presence felt, not only by raising the temperature of the sea 7° above that of the air in the months of December and January, but by frequently casting up seeds of tropical plants on the shores of the different islands. During the severe gales of wind that often occur, there is usually a good deal of salt in the atmosphere, hence the extreme difficulty of growing trees, or even shrubs, although there are a few exceptional plants that do not seem to be much affected by this, such as different kinds of evergreen shrubby Veronicas, and a few other plants, such as the New Zealand Manuka, or Captain Cook's Tea-plant (*Leptospermum scoparium*), the Pernettya mucronata, and the Japan Euonymus, &c., which, favoured by the mildness of the winters, thrive remarkably well, and to all appearance the New Zealand Flax Lily is likely to prove as well adapted to the climate of Orkney as any of them.

About eight years ago, or rather more, I got some of the seeds from a friend in New Zealand, which I raised in a hotbed in St. Andrew's, and during the same season I planted out several of them in the open air in my garden at North Ronaldshay, Orkney, where they have remained ever since, with no protection beyond the proximity of a low wall, some having a southern exposure and others an eastern aspect. These plants seem in no way affected by the winter, except that the tips of their leaves become somewhat frayed and ragged, but in the course of the following summer they soon recover their beauty, and they have gradually increased in size, until the leaves on some plants now measure from 5 to 6 feet, and in others from 6 to 7 feet long.

It was not until the first week of June, 1879, that my plants showed any signs or flowering, but I then observed that (of the three largest plants) two were throwing out each two flower-shoots; the third and largest plant, however, produced no fewer than five flower-stalks, enveloped by long sheathing leaves that closely embraced the stems, which were at this time from four to five feet high; the upper part, which evidently contained the future flower, being inflated, and tapering to a point at the apex, not unlike the head of a spear. They increased in length at the rate of about an inch a day; the swollen mass of spathes separating, successively unfolding, revealing numerous bunches of flower-buds, until when the stem reached the length of 8 to 9 feet, there were twelve or fourteen distinct clusters of flower-buds of a purplish-brown colour, disposed alternately on each side of the stem. The spathes at this stage added much to the effect, their interior being of a deep orange colour. Our weather had been rather dry for some time, which seemed to retard the opening of the buds; but after a heavy shower of rain on August 1st, the buds rapidly increased in size, and in three or four days the first flowers opened; they were tubular in shape, 1½ or 2 inches in length, of a deep red colour, with projecting orange stamens. The odour of the flowers was powerful, like that of Russia leather. It seemed to be very attractive to bees, moths, and other insects. Each main stem bore at least 300 flowers. Altogether it is a most magnificent example of the Lily family, and the general appearance of the plant is highly suggestive of tropical vegetation. It is well known that the fibre of the leaves possesses extraordinary tenacity, though, from its containing a large quantity of silica in its composition, the economic value of the plant has hitherto fallen short of what was at first expected. For the manufacture of ropes and cordage, however, I should think it most valuable. The leaf, even in its natural state, is so strong and pliable, that I have seen strips of it torn off and used as boot-laces, and it is evident that the flower-stalks partake of the same tough character as the leaves, as they were not at all damaged by the equinoctial gales of last September, though they were not tied to sticks or otherwise secured from injury. I may add that the flowers, after lasting for some two months, were succeeded by numerous seed capsules containing apparently well ripened seeds.

NORWEGIAN AND SWEDISH FORESTS.

Wood-cutting in the Norwegian forests, says the *Builder*, commences towards the end of the autumn or the beginning of winter, as soon as the circulation of the sap ceases. It is always an arduous, and sometimes a dangerous, occupation, for the localities of the forests are very lonely, and far removed from habitations, so that the wood-cutter is unable to return home for the whole week, but has to camp out in a little fir-log hut, taking with him sufficient provisions for the week, and keeping up a good fire with the branches, without which, indeed, his life would be insupportable. On Sunday he returns, following the tracks through the snow, made for the carriage of the timber, and guarding himself in dangerous places by wearing a pair of long wooden skates called "ski." After a time, when the roads become more marked, and the marshy ground is frozen over, the timber is brought away by the hardy Norwegian horses to the banks of a stream, where it is piled up in heaps called "tommerlunder," and there marked with the peculiar cut of the owner of that part of the forest. As soon as the rivers are free in the spring, the timber is floated down, a good deal of ingenious engineering being displayed in the formation of little artificial lakes to facilitate the passage when the water is shallow, while every now and then a chain of wood, called "laendser," is thrown across the stream to assist the course of the timber fleet, and enable it to be broken up and distributed according to the marks and destination. The whole of this part of the business is managed by a committee of forest proprietors, everything being done strictly according to rule, and the expenses divided by a regular tariff. This "flotation" is an operation which requires very skilful and experienced workmen, for the difficulties are neither few nor trifling. If the timber fleet does not arrive at the shipping port at the proper time, the wood has to be left in the water until next season, which represents a considerable loss of capital, not only in the deteriorated quality, but in the loss of the market.

A rough estimate of the value of the Norwegian forests has put them down at about 550,000,000 of francs, or £22,000,000; and, according to the last census, 13,638 persons were occupied in the wood-cutting and the rafting, the greater part of the men being unmarried and between twenty and thirty years of age. A curious calculation was made in 1870, as to the distribution of the forests in regard to consumption, when it appeared that out of 446 communes or parishes, 102 had a good deal more building-timber than was sufficient for their own wants; 129 had as much as they wanted, and no more; while 215 had not sufficient, and were compelled to buy. In the matter of firewood, 139 parishes were more than amply provided for; 173 had just enough; and the remaining 134 had to buy. The exportation of timber from Norway has doubled during the last quarter of a century, the principal ports for the timber trade being those on the Skagerak, to the east of Cape Lindesnaes; while the ports on the west and north of it scarcely send away

more than 4 per cent. of the whole. By far the largest quantity (about 78 per cent. of the whole) is sent away from the ports between Skiensfiord and the Swedish frontier. The following are the proportions of the different timbers exported in 1870 and 1875 :—

	1870. Per cent.	1875. Per cent.
Rough or squared timber.....	30·6 ..	38·7
Sawn timber.....	48·6 ..	37·9
Planed timber.....	10·9 ..	14·5
Small, for fire or pit wood....	7·7 ..	5·7
Small, cut for staves, &c.....	2·2 ..	3·2
	100·0	100·0

The latter item consists principally of birch wood, and is insignificant, by far the largest portion of the exportation being composed of fir and pine. The numbers mentioned before of those who are employed in the forest trade, of course do not include the still greater number of those occupied in the supplementary wood trade, such as makers of matches, wood oil and wood paper, the figures of those engaged in these industries, being 50,780 persons, in addition to 662 saw-mills, occupying 6,350 workmen. The following table shows the average rate of timber exportation between 1870-74, in stères (1 stère=1⅓ cubic yard) :—

Great Britain ..	1,308,400	Stères, or	55·3 per cent.
France	321,600	,,	13·6 ,,
Holland	267,900	,,	11·3 ,,
Germany	190,000	,,	8·1 ,,
Denmark	134,100	,,	5·7 ,,
Belgium	90,500	,,	3·8 ,,
Other countries .	35,000	,,	2·2 ,,
Total.....	2,347,500	,,	100·0 ,,

The average value of timber exported between 1871-75 was 61,000,000 francs per annum, at the average price of 20s. 9d. per stère. There are also exported about 250,000 kilogrammes (1 kilogramme=2⅕ lb.) of oak bark every year, together with an average of 4,500,000 kilogrammes of wood pulp for paper-making. This branch of trade, however, is largely increasing, and in 1878 it amounted to more than 19,000 tons—a very large amount, seeing how recent is the commencement of the trade of making wood pâte, few of the factories dating further back than 1870. The Norwegian Court in the Paris Exhibition last year was characterised by a very fine series of exhibits of wood, from the cut balks of pine to the various consistencies of pulp, and finally the paper resulting from it. One very striking application of the pâte was on wall, cornice, and moulding decorations, which possessed a remarkably clear and sharp outline, and is evidently well adapted for ornamental building purposes.

The forest riches of the neighbouring country of Sweden, are so great, that, after supplying our own wants, she is able to export very large quantities. Like the Norwegian forests, those of Sweden are composed principally of different species of fir and pine, birch, alder, and aspen trees, with the oak in the provinces south of the Dalelf, and the beech in the still more southern districts. In addition to the true forest, almost all the large properties, whether State or private, possess immense pasturages, more or less wooded with the trees above mentioned, as well as with ash, elm, maple, lime, &c., while some localities in Middle and Southern Sweden possess large plantations of mulberry trees. It is somewhat difficult to give an exact computation of the Swedish forests, as Lapland, which contains large woods, partly the property of the State and partly that of private individuals, has not been yet surveyed. Swedish territory, deducting the rivers and fiords, occupies 40,672,000 hectares (1 hectare = 2½ acres), from which should be substracted 4,693,000 hectares for fields and cultivated land, leaving 35,979,000, which may be classed under forest-land. But a great proportion of this is rough and desolate moorland, strewn with great rocks and intersected by bogs and marshes, so that we cannot place the true forests at more than 16,443,000 hectares, or about 40 per cent. of the whole country ; and at least two-thirds of this are situated to the north of the Dalelf, the southern provinces being comparatively sparsely wooded. Of all the rough and forest-land, 5,221,500 hectares belong to the State (about 15 per cent.), and the remainder of 30,757,500 to private owners.

CORRESPONDENCE.

TECHNICAL EDUCATION.

In the very able paper by Professor John Perry, reported in the current number of your *Journal*, there occurs a passage in reference to a paper recently read by myself, upon which I desire to make a few remarks. It is evident that Professor Perry has only partially apprehended the matter, when he makes the assertion that the gist of my paper was that the trade school system of France and Germany should be planted in this country, whereas what is wanted in England is a good system of technical education. I should have thought that any unbiassed reader of my paper could hardly have built up an antithesis of this kind out of my remarks. I have insisted again and again that what is wanted is a good system of technical education ; and I have contended that in that vast organisation—for vast and varied it must indeed be if it grows to proportions worthy of the importance of its aims—there will be some place for schools more or less resembling some one of the many types of trade schools or apprenticeship schools existing on the Continent. Professor Perry appears to mistake the part for the whole. The project for establishing apprenticeship schools, in certain selected industries to which they are more particularly adapted, is but a very small part of that which must be done towards a complete system of technical education. I have strongly urged that technical classes, established in the heart of every industrial centre, would be a powerful means of promoting the kind of training we desire for skilled workmen. The difficulty of obtaining teachers who are at once practical workmen and trained students of applied science, points so distinctly to the necessity of organising a technical college or colleges, and possibly, in time, a technical university, that no man who has thought even for a few months over the subject, and who is acquainted with educational systems in general, can dream of a system of technical education in which these are ignored. It appears to me, therefore, that Professor Perry is hardly just in attempting to represent me as propounding the establishment of trade schools as an alternative to a "good system of technical education." It would be equally fair or logical on my part, if I were to assume from Professor Perry's lecture that he advocated training technical teachers by sending them out to Japan, instead of sending them to a college or university in England—which I can hardly suppose to be what Professor Perry intended to advocate.

But having now disavowed the very one-sided views imputed to me, I may perhaps be permitted to explain what the views are which my study of this many-sided question has led me to adopt. A system of education in applied science, be it ever so perfect, which begins where the elementary schools leave off, and which includes education in technical classes, schools and colleges, will still be, to a very large extent, a failure if it leaves apprenticeship where it is to-day. I do not want, and I have always so expressed myself, that we should copy

any existing Continental system for the reorganisation of apprenticeship. But, having the problem before us, we cannot afford to lose sight of the solutions which have been attempted in other countries. If we leavé apprenticeship where it is, that is to say, continue to propagate in the workshops of this country that which is in too many cases worse than no training, it is hopeless to think that evening classes will remedy the defect, however clever the teachers. It is utterly hopeless to expect good results if a boy's teacher is teaching him by night that rule of thumb is no good at all, when by day that same boy's master, and overlooker, and fellow-workmen, are all teaching him, in language a hundredfold more significant, that rule of thumb is the only safe guide. Let it be clearly understood that I do not imagine that any one type of trade-school will suit the needs of apprenticeship in all trades. There are some trades—iron ship-building, for example—which, in the nature of things, cannot possibly be taught in a school: here some other of the types of scientific apprenticeship I have advocated must be applied. On the other hand, I have distinctly pointed out that there are trades in which, whether from the extreme division of labour, as in the watchmaking trade, or from the extremely local and restricted nature of the industry, as in the jet manufacture of Whitby, no other solution to the problem of a scientific apprenticeship seems to be so satisfactory as that of the apprenticeship school. The enormous help afforded by the Apprenticeship School of Besançon to that remarkable wave of industrial progress which swept four-fifths of the watchmaking industry from one side of the Juras to the other, is a phenomenon not to be lost sight of. So soon as a similar result is obtained by the technical night-classes, which appear to subtend so very large an angle in Professor Perry's eyes, I shall be prepared to modify my views upon the advantages possessed (in certain trades) by the trade schools, which he deems an inferior solution to the problem.

The experiment being tried at the Cowper-street Schools is a most valuable one, and one from which good results, and nothing but good, are sure to flow; and the City and Guilds Institute are to be congratulated on having the services of so excellent a teacher as Professor Ayrton is known to be. The remarks of Mr. H. T. Wood on the advantages to workmen in London of such an institution seem to me to be particularly well-timed.

I will only add that the suggestion thrown out by Mr. Owen Roberts—as to the importance of getting a Royal Commission to report upon the whole question of apprenticeship—is so valuable, that it ought not to be suffered to drop. No general scheme of technical education can be framed which does not recognise the relation of apprenticeship to education in general. And, assuredly, the suggestion has not come too soon to be heartily endorsed by all promoters of technical education.

Silvanus P. Thompson.

GENERAL NOTES.

Arsenical Colours.—As bearing upon the question discussed in Mr. Carr's paper on "Our Domestic Poisons," read before the Society of Arts on the 21st January, it may be recorded here that the Home Secretary, Mr. Cross, has ordered an extension of the special prohibition relating to places forbidden for meals in the Factory and Workshop Act, 1878," "to every part of a factory or workshop, in which dry powder or dust is used in any of the following processes — lithographic printing, playing-card making, fancy box making, paper staining, almanack making, artificial flower making, paper colouring and enamelling, colour making." The order is dated January 29th, and takes effect on February 1st.

Goldsmiths' Art.—The Goldsmiths' Company have, for the ninth time, offered a series of prizes, with a view to the encouragement of technical education in the design and execution of works in the precious metals. There are one prize of £50, two of £40, one of £35, one of £30, ten of £20, four of £15, and two of £10. Everything offered for competition must have been made within the present year, and by a British subject, and the prizes will only be given to the actual executants. The prizes will be awarded in the month of December next, and objects of art and workmanship must be sent by the competitors to Goldsmiths'-hall, addressed to the care of the Clerk, in the week ending the 27th of November. The Company have also resolved that a travelling scholarship of £100 may be awarded by the Wardens to a student who has shown exceptional talent, and who shall have obtained prizes for design or modelling in three competitions, in order to enable him to study art in the precious metals on the Continent of Europe.

Disease in the Tropics.—It will be noted in the announcements that a paper on "The Causes of Disease in Tropical Countries" is to be read on the evening of February 17th, at a meeting of the Foreign and Colonial Section, by Mr. A. W. Mitchinson, a traveller, who has resided two years and a half in Persia, and subsequently in Russia, and who has visited the Gambia, the Upper Niger, the Gaboon country, Angola, Benguela, Bihe, Lake Ngami, and Walfisch Bay. Mr. Mitchinson was originally educated at Liepzig University, and has given a large share of attention and thought to various matters of a practically scientific character, and amongst them to that which is to be the subject of his communication, one purpose of which seems to be to point out that personal habits have much more to do with the preservation of health in tropical travellers, than the more extraneous circumstances of climate, and exposure to malarious influences.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

February 11.—"A New Metallic Compound and its Application to Industrial and Artistic Purposes." By Granville Cole, Ph.D. George Godwin, F.R.S., will preside.

February 18.—"The Euphrates Valley Railway." By W. P. Andrew.

February 25.—"The Noxious Gases Bill." By E. K. Muspratt, F.C.S.

March 3.—"The History of Musical Pitch." By Alexander J. Ellis, F.R.S.

March 10.—"Recent Advances in the Production of Lambeth Art Pottery." By John Sparkes. Sir Philip Cunliffe Owen, C.B., K.C.M.G., will preside.

March 17.—"The Art of the Silversmith." By W. Herbert Singer.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

April 14.—"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 17.—"The Principal Causes of Disease in Tropical Countries, Scientifically Considered." By ALEXANDER WILLIAM MITCHINSON, late Student of Liepzig.

FEBRUARY 24.—"Views of Colonization." By WILLIAM FORSTER, of New South Wales. Sir CHARLES NICHOLSON, Bart., will preside.

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

FEBRUARY 12.—"Gas Furnaces and Kilns for Burning Pottery." By HERBERT GUTHRIE, C.E.

MARCH 11.—"Balmain's Luminous Paint." By C. W. HEATON, F.R.S. Professor H. C. ROSCOE, F.R.S., will preside.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S., will be delivered on February 2, 9, 17, 23; March 1, 8.

LECTURE II.—FEBRUARY 9.

Mechanical and chemical purification. Working of unvulcanised caoutchouc. Formation of blocks, sheets, and threads. Elastic webbing. Other uses of unvulcanised India-rubber.

LECTURE III.—FEBRUARY 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—

April 5, 12, 19, 26; May 3, 10.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and ONE friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 9TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture II.)
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major-General Sir Michael A. S. Biddulph, "Afghanistan: The Eastern Border of Pishin, and the Basin of the Loras."
British Architects, 9, Conduit-street, W., 8 p.m. Adjourned Discussion on Mr. Thomas Porter's Paper on "Architectural Competitions."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Rev. J. G. Wood, "Hibernation, Aestivation, and Migration."

TUESDAY, FEB. 10TH...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture V.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, S.W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. John James Webster, "Iron and Steel at Low Temperatures."
Photographic, 5A, Pall-mall East, S.W., 8 p.m. Annual General Meeting. Dr. W. Huggins, "Photographs of the Stellar Spectra."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. Dr. Emil Holub, "The South African Tribes from the South Coast to the Zambesi."
Royal Horticultural, South Kensington, S.W., 1 p.m.
Metropolitan Scientific Association, 13, Blomfield-street, Finsbury-circus, E.C., 7 p.m.

WEDNESDAY, FEB. 11TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Dr. Granville Cole, "A New Metallic Compound and its Application to Industrial and Artistic Purposes."
Microscopical, King's College, W.C., 8 p.m. Annual Meeting. Address by the President.
Royal Literary Fund, 10, John-st., Adelphi, W.C., 3 p.m.
Society of Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. A. T. Maginnity, "New Zealand Telegraphs." 2. The President, "Note on the Durability of Iron Wire." 3. Mr. A. Eden, "Morse Signalling by Magneto-Electric Currents." 4. Mr. C. H. Wilson (Chicago), "Compensating Induction in Parallel Wires."

THURSDAY, FEB. 12TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Applied Chemistry and Physics Section.) Mr. Herbert Guthrie, "New Furnaces and Kilns for Burning Pottery."
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Rev. Prof. Sayce, "The History of Writing."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. George Bertin, "The Art Culture of the Ancient Assyrians."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Processes." (Lecture III.)
Royal Historical, 11, Chandos-street, W., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m. 1. Prof. H. J. S. Smith, "Geometrical Notes." 2. Lord Rayleigh, "The Reflections of Vibrations at the Confines of Two Media, between which the Transition is gradual: and on the Stability or Instability of certain Third Motions."

FRIDAY, FEB. 13TH...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Mr. W. H. Preece, "Wheatstone's Telegraphic Achievements."
Astronomical, Burlington-house, W., 3 p.m. Annual Meeting.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
New Shakespeare, University College, W.C., 8 p.m. Mr. J. Craig, "Shelley's Use of Shakespeare."

SATURDAY, FEB. 14TH...Trade Guilds of Learning (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.
Physical, Science Schools, South Kensington, W., 3 p.m. 1. Annual General Meeting. 2. Dr. W. H. Stone, "A Quartz Iceland Spar Achromatic Spectroscope."
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Pauer, "Sebastian Bach" (with Musical Illustrations).

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FRIDAY, FEBRUARY 13, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TENTH ORDINARY MEETING.

Wednesday, February 11th, 1880; GEORGE GODWIN, Esq., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Barneby, William, J.P., Saltmarshe-castle, Bromyard, Hereford.
Hodd, Richard, jun., 30 and 31, Hatton-garden, E.C.
Lyon, C., Oakleigh, Sunninghill, Berks.
Mondy, Edmond Felix, 36, Casella-road, New-cross-road, S.E.
Montague, Charles, 32, Cannon-street, E.C.
Muggeridge, R. W., Messrs. Barclay, Perkins, & Co.'s Brewery, Park-street, Southwark, S.E.
Norton, George, M.A., F.R.G.S., 2, Gloucester-place, Hyde-park, W.
Oakeshott, Jonathan, 4A, Sloane-square, S.W.
Tennant, Charles, M.P., The Glen, Co. Peebles.
Warner, Thomas, 47, Sussex-square, Brighton.
Whitworth, Frank Hoyland, Ormside-house, Upperthorpe, Sheffield.

The following candidates were balloted for and duly elected members of the Society:—

Kennard, James, F.R.G.S., Morton-house, Middleton, Lancashire.
Ness, James Sharp, 265, Camden-road, N.W., and 21, Milk-street, E.C.
Paine, Cornelius Henry, 1, Harley-place, W.

The paper read was:—

A NEW METALLIC COMPOUND.

By Granville Cole, Ph.D.

The paper which I am about to read this evening, affords me the privilege of appearing for the first time before a meeting of the members of the Society of Arts, and I hope you will grant me your indulgence for any shortcomings which may attend this, my first appearance as a public lecturer in England.

The subject of the paper is the discovery of a metallic compound, which I shall prove to you is new, and I shall endeavour further to set forth a few facts, attested by experiments, in respect of its nature. I am duly impressed with the very technical character of my subject, and the tendency there must be, in dealing with it, towards a certain dryness in my remarks. But, while I trust that many of the *data* will appeal with special interest to engineers and other practical men, I still hope to arrest your attention by showing you to how many artistic and industrial purposes this new metallic compound may be put. In the first place it will be right to give a brief account of the

I.—DISCOVERY OF THE METAL.

Nearly a year ago, Mr. J. Berger Spence discovered that the sulphides of metals, combined with molten sulphur, formed a liquid. This liquid, on cooling, became a solid homogeneous mass, possessing great tenacity, and having a peculiar dark grey—almost black—colour. Nearly every metallic sulphide which is known, combines, as experiments have proved, with an excess of sulphur, and curiously enough, nearly all these combinations have the same properties. The combination, of which I have specimens here for inspection, consists of an ore of iron pyrites containing both lead and zinc sulphides.

II.—CHEMICAL COMPOSITION.

Examining the metal from a chemical point of view, I may state, briefly, that it is a chemical compound belonging to that class known as thiates, or sulphur sulphides.

Dr. Hodgkinson, chemical demonstrator at the Science Schools, South Kensington, has kindly sent me the following facts. I cannot do better than quote his letter on the subject:—

"It appears to be the easiest thing in the world to obtain a homogeneous casting with it. Specific gravities of portion sent gave 3·3743 to 3·7036 (reduced to 0° C.)

"When finely powdered, it is acted upon slowly by concentrated HCl. and NO^2 HO in the cold; in large lumps, little or no action takes place. As yet I have not been able to determine the expansion equivalent accurately; it would appear, however, to be small. The fracture is not conchoidal, as might perhaps have been expected, but somewhat like that of cast-iron.

"I have not had time to try many 'utilisation experiments' on the substance, but I have no doubt it would be exceedingly useful in the laboratory, even, for instance, for making the air-tight connections between glass tubes by means of caoutchouc, and a water or mercury jacket, where rigidity is no disadvantage; the fusing point is so convenient, about 340°, that it may be run into the outer tube on to the caoutchouc, which it grips, on cooling, like a vice, and makes perfectly tight.

"I don't know what you may call the material, but should think, as it seems to be more than a mere mixture, 'ferric thiate' would not be a bad or inappropriate name."

III.—PROPERTIES OF THE METAL.

I propose, this evening, to illustrate, by experiments such as are possible at a lecture, some of the properties of the metal. I will begin by giving you a short summary of its peculiarities, and its advantages over those of other metals or metallic compounds.

1. It has a comparatively low melting point, viz., 320° Fahr., or rather more than 100 above the temperature of boiling water. Here, then, we have in its favour the small amount of fuel needful to supply the necessary heat for reducing the metal to a condition for use.

2. It expands on cooling, a property not shared by the majority of other metals or metallic com-

pounds. I believe that type metal and bismuth are two exceptions. Later on, I think I shall convince you that, for an operation like the joining of gas and water pipes, this expanding property is one of great importance.

3. It claims to resist atmospheric or climatic influences, as compared with bronze and marble. I noticed only a few days ago how the statues in bronze, on the Holborn-viaduct, had been affected by our London fogs. And I have evidence to produce in the direction of showing the imperviousness of the metal to such degrading influences.

4. As compared with other metals or metallic compounds, its resistance to acids, used commercially, to alkalis, and to water, is certainly superior.

5. A smooth surface of this metal or metallic compound, now known commercially as Spence's metal, takes a very high polish. I will illustrate this to you by casting some of this molten metal on to a surface of glass.

IV.—Its Uses to Art.

It may, perhaps, be interesting to my hearers to learn the manner in which Mr. Spence first thought of utilising this metal for works of art. In order to obtain a perfectly smooth surface, he had been running molten metal on to a piece of glass as I have just done. But before doing so, he had chanced to touch the glass, and had left the marks of the pores of the skin of his fingers upon it. On removing the metal, these marks were found to be reproduced, and so indelibly that they did not disappear on polishing the surface metal. This led Mr. Spence to try to cast the metal in a mould; and although at present no artistic work of high order has yet been reproduced, yet I venture to think that enough has been done to justify the expectation that, in a short time, standard works of both ancient and modern art may be successfully and usefully reproduced. Various colours, such as the green patina of bronze, the dark blue hue of steel, and the appearance of silver and gold, have already been obtained. Experiments are now in progress, which give promise of enabling those who adopt this metallic compound for such uses, to reproduce metallic works in their original colours.

I have here a casting that was made from a nickel-plate engraving; every line, however minute, has been reproduced in Spence's metal. Experiments are now being carried on to test the adaptability of the metal for printing and stereotyping purposes, but they are not complete, so I refrain from giving you any facts about them.

Besides this, experimental castings have been made of various medallions and busts; notably, this large bust of her Majesty the Queen. The metal in this case has not subsequently been treated in any way beyond being polished with a cloth. The metal can be cast into almost any material used for moulds.

Mr. Spence has succeeded in obtaining casts from metal moulds, plaster moulds, and even from gelatine moulds. These last are probably the first metallic castings produced from gelatine moulds. Spence's metal being almost a non-conductor of heat, cools so rapidly in the gelatine mould that it yields a perfect impression before the form of the mould is destroyed, and if the gelatine be allowed to remain on the metal till cold, it remodels itself ready for the next casting. It is, therefore, hoped that an additional process has been secured, by which the most undercut objects may be reproduced successfully and easily.

The advantages which Spence's metal possesses over other materials used for artistic productions, may be summarised under three heads, viz.:—1. Cheapness. 2. Facility of working. 3. Resistance to climatic influences.

Cheapness.—As compared with lead, which is one of the cheapest of metals, it is one-third the weight; and, whereas the average cost of lead for the last ten years has been nearly £18 a ton, Spence's metal only costs £15. A ton of Spence's metal being three times the amount in bulk of that of a ton of lead, it is available for three times the amount of work. It may, therefore, be considered to be nearly a quarter of the price of lead, and, consequently, very considerably less than that of bronze.

Facility of Working.—Its melting point being very low, it can be very easily prepared for pouring into a mould, and its property of expanding, when cooling, causes it to take such a perfect impression, that the cast requires very little chasing after. In respect of a gelatine mould, which can cover a considerable surface of work without joins, such as one has to make in plaster piece moulding, the metal cast obtained from such a mould would require no chasing whatever.

Resistance to the Atmosphere.—With regard to its resistance to climatic influences, experiments have been conducted in this direction with complete success. A polished surface of the metal has been exposed for six months in all weathers, without showing the least change.

Mr. Wood, the Secretary of this Society, has had a medallion, which I sent him a month ago, exposed to all the recent fogs and frosts, on the outside of this building. You can judge and see for yourselves how well it has stood this test.

Not to confine myself to his test alone, I have here another medallion of this metal, which Mr. Wood tells me has been left for the same period in aqua-regia, one of the strongest acids known. You see how little effect the acid has had on the surface of the metal. I believe that no work of art in any other substance would bear this test without suffering. I will here endeavour to show you the effect the same acid has on marble or bronze. I venture to think that if Spence's metal has resisted this acid for a month, it ought certainly to be able to resist the climate of London for a very much longer period. I, therefore, beg to submit that this metal, if skilled labour is brought to bear on it, ought to be of a great value for decorative purposes, both internal and external.

V.—Industrial uses.

I will endeavour now to point out to you the uses to which this metal may be applied for industrial purposes. And I propose to divide these purposes under three heads:—1. Gas and Water-works. 2. Chemical works. 3. Miscellaneous.

Gas and Water-works.—As practice is better than theory, I will simply relate, as best I can, those experiments which have been tried at the South Metropolitan Gas-works. Experiments, under the direction of Mr. Livesey, were made some weeks back; two pipes were joined by this

metal in much less time than would have been taken had lead been employed. The pipes, after having been joined, were tested under pressure, but no leakage was found.

Method of Joining Pipes with Lead.—In order to show the especial advantages this metal has over lead, it will be as well here, if I endeavour to tell you how gas or water-pipes are joined when lead is used. The pipes having been laid together, the joint is packed with yarn; clay is then laid round the exterior of the joint, and the molten lead is run in. Unfortunately, lead possesses the property of contracting on cooling. The leaden joint has, therefore, to be "caulked," or as it is called in the north, staved. This caulking, or staving, means wedging the lead into the joint, in order to obtain a perfectly tight join. This caulking naturally occupies considerable time, and necessitates excavation, in order to allow the men to work all round the pipes.

Excavation and caulking are both rendered unnecessary by the use of Spence's metal. The pipes have only to be laid together, and after the yarn has been forced into the joint and the clay placed, the liquid metal is run into the joint, the clay is removed, and the joint is finished. The metal does not splash in running into the mould, thus avoiding a great source of waste of material, and danger to workmen.

Experiments were also tried to test the metal joints in the event of subsidence of the ground. Four lengths of nine feet piping, six inch diameter, were joined with the metal, and supported on trestles. After the metal had set, which it did in a few minutes, the centre supports were knocked away, leaving only the two end ones. The thirty-six feet length of piping sank seven inches, without showing, even after pressure, a leakage.

These experiments were so satisfactory, that the South Metropolitan Company have adopted the metal, and are now laying their pipes with it. Mr. Livesey, the chief engineer, in writing on the subject to Mr. Spence, says:—"We have now only the test of time, and that, I think, we may take the risk of." Others of the London gas-works, and a very large number of provincial gas-works, are adopting it.

In the same way, it will be useful for water-works. Mr. Hope, who undertook some experiments in Scotland, reports that at the Edinburgh Water-works two pipes were joined, and subjected to a pressure of 400 feet of water, which was as much as they could get on without the joint showing any leakage. This is the greatest pressure which we have as yet been able to put it to; so what it will actually bear, I am not at present in a position to say.

From a sanitary point of view, as water has no action on the metal, it would be extremely valuable for cisterns, instead of iron or lead. Being almost a non-conductor of cold, pipes might be lined with it to prevent the water from freezing.

Uses to Chemical Works.—The metal being less acted upon by acids than other metals, it may also be of service to chemical manufacturers. I refer especially to sulphuric acid, which is the most extensively used of all acids in commerce. Lead has, up to the present, been used for sulphuric acid tanks. I have myself tested the metal with sulphuric acid, and its action is almost imperceptible. The one objection to the use of this metal in this case is its low fusing point, but when acids have only to be used up to a certain temperature, say 200° Fahr., I venture to predict a large field for its use.

VI.—Miscellaneous Applications.

Besides the uses I have thus briefly and, I am afraid, somewhat imperfectly set before you, there are many others to which the metal may be applied, for instance, joining iron to stone or wood, the tensile strain of the metal being from 650 lbs. to the square inch five minutes after setting. For joining railings to stone it would answer equally as well as lead, and cost very much less; also for coating the holds of ships. I have been told that an Act of Parliament has been passed by which builders are compelled, if the district surveyors desire, to cover the walls of houses after they are built two feet out of the ground, with some material to prevent the damp from rising. It seems to me that Spence's metal is peculiarly adapted for this purpose.

I will illustrate to you some of the other uses to which this metal may be put. For hermetically sealing bottles; for covering cloth; for covering parcels that are being sent out to hot climates, thus obviating the use of lined boxes; for preserving fruit, or other articles of consumption; and I may state that experiments on a large scale are still being carried on at Mr. Spence's works, Belvedere, Kent.

VII.—Conclusion.

I feel sure we have not yet come to the end of all the uses this Spence's metal may be put to, but I trust that I have shown you sufficient to induce you and others who may be interested in this discovery to make further investigations. If my paper is somewhat shorter than is usual, it is to some extent owing to my hesitation to make any statement which either Mr. Spence or I have not verified by actual experiment ourselves. I have already shown you a few of them, viz., casting on glass, casting an engraving, casting in metal moulds, casting in plaster moulds, casting in gelatine, resistance to atmospheric action, resistance to acids, resistance to acids as compared to bronze or marble, and uses in gas and water-works. In conclusion, I express a hope that I have established the proposition with which I started, and I trust you are satisfied that this Spence's metal is a discovery which has a prospect of much utility to the fine and industrial arts, and that I have been justified in bringing it before the attention of the members of the Society.

DISCUSSION.

The Chairman said Dr. Cole had certainly proved that there was in one way or other a very large field for the employment of this new metal. It was very curious to see how an invention first made with a particular object, sometimes took afterwards an entirely different direction. This material was first brought forward as affording admirable reproductions of works of art, and now they were informed that it could be used to preserve fruit, and possibly meat, and so it might solve the difficulty of bringing over American and Australian meat. This re-

minded him of an admirable invention for wood-carving, which made no way at first, but when troubles overtook France, and prevented the exportation of wooden heels for ladies' shoes, all the machines in London were immediately set to work profitably. So with Mr. Ransome's patent stone; it did not seem to take until it was turned to making large grindstones, for which it was admirably adapted. The same thing might occur in this case. This metal was already in profitable use for joining gas and water pipes, where it possessed considerable advantages, not merely because lead required wedging in, in order to make a tight joint, but very often from the difficulty of getting at the under side of the joint, it was imperfectly accomplished; whereas this metal, from its fluidity, penetrated all round, and so made a good piece of work of it. It must not be too readily taken for granted, that its power of resistance was proved; because, though it had been exposed for seven or eight months, that was really nothing in point of time; they had bronzes thousands of years old which were still perfect, though others, imperfectly made, such as some in that metropolis, which were not twenty years old, were already decaying. The last time he had looked at the paws of the noble lions in Trafalgar-square, he noticed they were full of holes; and if some means were not devised for preventing further decay, their ruin was certain. However, what they had already heard, said a good deal for the durability of this metal. It was quite certain they needed a material for the reproduction of works of art which should be cheap, hard, and durable. Sulphur itself, had considerable power of resisting atmospheric influence, and many other reasons might be suggested why this compound might be expected to be durable; and if so, it would be a great boon for artistic purposes; but there were many other directions in which it would be useful, as, for instance, the joining of iron railings to stone copings. Probably owing to galvanic action, lead, which was generally used, had a very prejudicial effect on the stone. After the popular outbreak in Hyde-park, which led to new railings being put up, he noticed, within a year, that at every ten or twelve feet, where the iron bars were thicker than usual, the piece of stone had been driven forcibly out of the kerb, which entailed a large expense in the repairs. Lead poisoning was another thing which naturally occurred to one, and if this could be used as a coating for pipes, or for the material of pipes, if not too brittle, it would have double the advantage of preventing the decomposition of the lead, and also the possibility of freezing.

The Secretary narrated the tests to which he had subjected the specimens sent him by Dr. Cole. When Dr. Cole first mentioned the compound to him, he said it was not liable to be affected by acids, and he (Mr. Wood) then suggested that if a couple of specimens were sent to him, he would himself test them, and relate the result to the meeting. One of these medallions he put on the roof of the Society's House about a month ago, and as they all knew, during the intervening period, they had had every possible description of bad weather. The time was not long, but if the material had been at all subject to atmospheric influences, it could hardly have failed to show some signs; at any rate the glassy surface would have been somewhat dimmed; but nothing of the kind was apparent. The other medallion he put into a basin with nitric and hydrochloric acid, about the strongest mixture of acids known to chemists. The surface of this had certainly been affected, and probably there were no substances except gutta-percha, or earthenware, which would have escaped. An iron hook, by which the medallion was intended to be hung, dissolved entirely in a few days. Dr. Cole also gave him a piece of the compound, with which he had experimented, and he found it exceedingly easy to work. You could take casts as easily as with wax. The only thing necessary was to get the right temperature. At anything under about 320° it was pasty, and if you went much beyond that temperature it became pasty again, but between 320° and 350° it was perfectly liquid, and could be poured into the very finest mould. He thought it rather a pity that a better name had not been devised for the material, as it was certainly not a metal.

Mr. Livesey said he had had some experience in regard to joining gas-pipes, and he would state the result. Lead was most unsuitable for this purpose in some respects, though it was universally used. It was expensive; it required caulking or setting up to make it tight, because it contracted in cooling; and, if you wanted to remove the pipes—which constantly happened, except in the very largest mains—from the increased consumption requiring larger pipes, the use of lead prevented your getting out the pipes without cutting them, which occasioned considerable loss. Various means had been tried for drawing pipes, but all had failed, and they always had to be cut. Another drawback was that lead, being valuable and easily disposed of, was constantly being stolen. Now, this new metal was free from all these disadvantages; the only thing which occurred to him, while listening to the paper, was that it seemed a shame to put so beautiful a substance to so base a use; for when he looked at those beautiful busts, it seemed a pity to use the same material for joining gas mains. However, it had many advantages for this purpose, not the least of which was its perfect soundness. The account given by Dr. Cole was quite accurate. The four pipes jointed in the Old Kent-road, as described, and supported at the two ends, were exposed to the most severe test, and when he purposely broke one of the joints at the conclusion of the experiment to see what the effect was, he found the metal had taken a perfect impression of the cast-iron. The South Metropolitan Gas Company were now using it instead of lead; the men had no difficulty in applying it; and the only test required was that of time, of which he had no fear. The only possible difficulty was that workmen, being accustomed to use a fierce fire to melt the lead, might make the metal too hot, and so burn the sulphur; but that could easily be guarded against. If required, it could be easily cut out with a chisel in order to remove the pipes; and another advantage was, that if from any cause it did not run quite round a large pipe and make a perfect joint, you could clean out the part which had not been filled, put a fresh piece of clay there, and fill it up with a little more metal, and thus the joint was made quite sound.

Mr. Cresswell wished to ask one or two questions, not with a view to throw a doubt on the utility of the invention, but rather to elicit valuable information. And first, he wished to compliment Dr. Cole on his paper, which had the rare merit, not only of brevity, but of being written in language so plain that any ordinary person could understand every word. Though brief and simple, it contained matter of considerable importance to the commercial interests of the country, because, if a substitute for lead had been discovered, it would be an immense advantage to everyone, except, perhaps, those interested in lead mines. If, on the other hand, it would serve the purposes of art, he could not conceive a greater boon to the large class of struggling population, who were endeavouring, both male and female, to earn a living by the pursuit of art. He wished to know, in the first place, if this material, when used for jointing pipes, possessed any elasticity; because he was told that it was absolutely essential to the permanence of gas-pipes under the London streets, with heavy traffic passing over it continually, that there should be a certain give and take, or elasticity in the joints. If, when heavy pressure was brought to bear on these pipes, they gave way at the joint, the value of the joint was reduced to *nil*. In the ordinary way, you first

caulked the pipe, then filled it with lead, and then caulked the lead, and thus produced an elastic joint, which would yield to such an extent that you might bend the pipe without destroying the continuity of the joint. If, on the other hand, this mettle was so brittle, that under any sudden pressure it gave way, it would be a formidable difficulty. The next question was this. He understood there was a project for bringing salt water to London from the sea, and one of the greatest difficulties, as he was informed, which the promoters would have to deal with, was to discover a joint for the pipes which would not be affected by salt water. If any means could be devised for cementing pipes which would allow of salt water being conveyed from Worthing to London, and remaining in the pipes for 48 hours or more, or even permanently, it would relieve the promoters of this enterprise of a great difficulty, and perhaps confer a great boon on the inhabitants of the metropolis.

Captain Heathorn asked if there were any galvanic action between this metal and copper, and also if it had been left for some time at the bottom of the sea, to see if barnacles and such things would adhere to it?

Mr. Waller asked if it would expand and contract in the same proportion as water-pipes, if used for hot water?

Mr. Spence said the joints would be considerably affected by hot water if the temperature were very high. Ordinary boiling water would not affect it; but, as it melted at about 300°, if there were a steam pressure of about 40 lbs. there would be such an increase of temperature that the joints would not stand. It did possess a certain degree of elasticity. In one case, 30 feet of pipes were connected with this metal at the joints, and deflected to the extent of eight inches, and, when the weight was removed, the pipes recovered their original position, showing that it was elastic to some extent. With regard to expansion and contraction, he was hardly yet in a position to speak. He would take this opportunity of stating that if ever this metal, as it was called, did take a place in art or industry, much of its success would be due to Dr. Cole, who had greatly assisted him in his experiments, and in elucidating the facts; and also to Mr. Livesey, who was the first to take it up in a practical way.

Mr. Livesey said lead was certainly not elastic; if you were to join four lengths of 9 feet together with it, caulking it up in the ordinary way, and then knock out the central supports, the upper part of the joints would squeeze into a narrower compass, and the lower would be left open, and when the pipes were again brought to a straight line, the lead would not return to its original shape. Lead was not elastic in any sense whatever, and it was, therefore, a very bad thing for pipes, where there was any settlement or change of position. This metal seemed to have the effect of making the four lengths into one continuous, perfect pipe, which had just the same strength in the joints as anywhere else. This was shown by the fact that when supported at the two ends it sagged evenly throughout, making a continuous curve, whereas if the joints had been made with lead, there would have been a number of straight lines, with angles at the joints.

Dr. Cole said he believed that salt water would have no action on the metal whatever. The same with regard to galvanic action, for which it had been tested. With regard to barnacles at the bottom of the sea, he regretted to say that no experiments had yet been made in that direction. He would conclude by another experiment, to show how quickly the metal set, namely, coating a pat of butter with it.

Whilst this experiment was being performed,

The Chairman proposed a cordial vote of thanks to Dr. Cole, which was carried unanimously.

MISCELLANEOUS.

ON SILK-PRODUCING BOMBYCES AND OTHER LEPIDOPTERA.

By Alfred Wailly

(Membre Lauréat de la Société d'Acclimatation de France).

I.—Preliminary Remarks.

In November, 1878, I hastily collected some notes on eight species of silk-producing Bombyces, which had been reared in England and on the continent of Europe; these were followed, during the spring and summer, 1879, by further notes on the reproduction of species in a state of confinement. These notes will be found in the following numbers of *The Entomologist*, December, 1878, January, 1879, and July, 1879; in the *Journal of the Society of Arts*, June 6th, and August 1st, 1879; also in *Isis*, Berlin, July 10 and 17, August 21, and August 28; also in the *Scientific American*, New York, July 19, 1879.

The principal part of my report this year will be on the rearing (for the first time in England) of *Attacus mylitta*, the Tusser or Tasar silkworm of India. But I shall first review some of the different Lepidoptera, of which I had a certain number of pupæ, for the purpose, when possible, of reproducing the species in a state of captivity; and I shall also state the effects of the weather on the various species. It is now only about six or seven years since I first commenced with the rearing of the large silk-producing Bombyces, and then extended the study to all species of which I could obtain pupæ, or ova, from abroad.

In the few scientific books on Lepidoptera which I have consulted, little information is given on the larvæ, and still less on the state of the insects, during the winter. Is the insect, during the winter, in the ovum, the larva, the pupa, or even the imago state? For some species, this is perfectly well known; for the rest, nothing is said on the subject. When ova of Lepidoptera are deposited during the autumn, will the larva always hatch of these species, which are given and considered as passing the winter in the larval state? If these ova be deposited too late in the autumn, or the weather be too cold, will not the hatching of these ova (which in ordinary and mild weather would take place during the autumn) be delayed till the spring? I cannot answer this question in a general way, through want of experience, but I can state a fact.

A few years ago, I received from France, in the month of May, a quantity of larvæ of *Bombyx trifolii*. In due time, I obtained the cocoons, the moths, the pairings, and a large quantity of fertile ova. These, instead of hatching during the autumn, only hatched at the end of February, the larvæ having remained in the ova, fully developed and in good condition, during several months. I opened, during the winter, the *trifolii* ova, as I had previously done the *Yama-mai's*, to see the living larva in the egg. *B. trifolii*, however, like *B. quercus* and other species, is one of those given as hybernating in the larval state. As a matter of fact, my *trifolii* were larvæ during the winter, but they were in and not out of the egg. Now, can this be called an accident, and is it not possible that ova of other species, which generally hatch in the autumn in favourable weather, may be naturally retarded by cold till the following spring, the larva remaining all the time fully developed in the egg?

This year, owing to the unfavourable weather, I went out collecting only three times, but not with the hope of catching anything valuable. The first and second times I found nothing at all, but on a third trip to the country I collected different larvæ, and also some pupæ

of a well-known insect, *Gortyna flavago*, the "Frosted Orange," at Esher (Surrey). I found this insect in the pupa state, and on the point of turning into pupa, at the end of July; in other places, I found very small larvæ of this species. As the larva feeds inside certain plants, such as thistles, burdock, elder, of which it eats the pith, I was desirous to know how the eggs were deposited, so I left a few moths in a cage, with a small branch of elder plunged in water. I expected to find the small eggs (which are perfectly spherical and of a buff colour) on the bark of the elder branch; but none could be seen on it; some were on the floor of the cage, not even glued, others were fastened to the sides of the cage.

Flavago, in one of my French books on Lepidoptera, is decorated with a pompous name, a privilege enjoyed by other species as well. It is styled, *le drap d'or*, "The Cloth of Gold," and I must confess that I never could detect this brilliant cloth on the wings of the little insect, even when armed with a powerful magnifying glass. It is true, in another book, the fine golden yellow colour of the upper wings is said to be covered with a dust of brown-red, which very likely conceals it from the eyes of ordinary mortals.

The *flavago* moth, which I had seen many a time before I had obtained specimens fresh from the pupa, I again considered to be a plain and modest-looking little insect, which I should very likely have found prettier had it not been labelled with such a grand and deceptive name. Unfortunately, now more than ever, it is the custom to give very big names to very small things.

With respect to silk-producing and other Bombyces, some, like *Sericaria mori*, *Yama-mai*, *Saturnia maia*, are in the ovum state during the winter; but, in some of these species, the young larvæ are formed a short time after the eggs have been deposited, and hybernate in the egg. Others, and these form the majority, cannot be preserved in the egg state during the winter; such are *Attacus cynthia* and *pernyi*, *Actias selene* and *luna*, &c. If I dwell on the subject, it is to answer many inquiries made to me by correspondents who had obtained eggs of *cynthia* and *pernyi* late in the autumn. The eggs of these two species—which are double-hooded, like *selene* and *luna*—hatch within a few days, or the larvæ die in the egg if the weather be too cold.

In course of time, much will be known respecting the state of Lepidoptera during the winter, as many entomologists in England and on the Continent take a great interest in the study of the living insect. M. le Marquis de Lafitole, of Beaune la Rolande, in France, who has published in successive numbers of *Le Naturaliste* a most useful calendar on larvæ of French Lepidoptera, where the names of the various food-plants are given for each species, wrote to me lately (27th September, 1879):—"As you say, I had lately the pleasure to see here Dr. Staudinger, and he must have been able to give you an account of my *organisation* arrangements. I rear an immense number of French Lepidoptera, of which I shall publish a catalogue."

II.—Effects of the Weather on Lepidoptera, Reared in 1879, &c.

This year, all species were more or less affected by the severity and duration of the winter, and the moths which emerged were three or four weeks later than usual. Many Sphingidæ pupæ died after the time for the emergence of the imago was over; pupæ of Bombicidæ were only retarded a few weeks, but others kept alive for the next season; of the latter I may mention *Endromis versicolora*.

Ova of *Yama-mai* (Japanese oak silkworm) were so much retarded, and what was worse, the weather was so bad during the time we generally call summer, that, at the beginning of September, when the insect ought to have been in its perfect state, I still had three wretched-looking larvæ in my garden, which, in spite of all their efforts, could not manage to spin, and eventually died. *Samia cecropia* and *Telea polyphemus* larvæ lingered till October, and died of cold and wet. Of *Samia cynthia* larvæ, reared on the Ailanthus trees in my garden, some spun up small cocoons; others, constantly driven from the places they had selected to form their cocoons, by torrents of rain, spread their silk about, and were always on the move. I collected many of these unfortunate creatures, which I slipped into paper bags; some succeeded in forming a kind of web, some turned into pupa without secreting any more silk, others could only die.

One of my correspondents in Belgium, who, during several years, has successfully reared *Yama-mai*, and *Pernyi* in the open air, on oak bushes, could this year (1879) only obtain a very indifferent crop. In Spain, also, partial failure attended the rearing of the oak silkworms, but the bad result was due to the opposite cause, the great heat and drought.

A correspondent in Spanish Estramadura, M. Monin, in his letter to me, dated November 7th, says:—"The average temperature in August was 42° Centigrade = 99° Fahr. in the sun, and 18° Centigrade = 67° Fahr. in the shade, and we had no rain at all during the whole of the month. The crop of *Yama-mai* cocoons was comparatively very small this year."

I shall now review the principal silk-producers I had this year, excepting those just above mentioned.

Attacus Pyri.—Moths emerged late, but all in good condition, and nine or ten pairings were obtained. A few cocoons remain alive.

Attacus Spini.—Only one moth emerged; several other cocoons have kept alive.

Attacus Carpini.—Not one moth emerged. Some cocoons left alive.

Attacus Pernyi (North China).—Of this species, I had a considerable number of splendid cocoons. To have only one rearing of this species, I placed the cocoons in the open air about the 8th of April, to delay the emergence of the moths. Of course, this would have been unnecessary this year, and, had I been a true weather-prophet, I should have kept the cocoons in the room where they were before. But the mistake was done, and a fatal one it was, for the cold was so intense and so tenacious that, when the moths emerged, I had a swarm of cripples. Most of them refused to pair, a very unusual thing with this species. The females that had paired laid eggs, which were nearly all unfertile. My Spanish correspondent in the province of Guipuscoa, M. de Nueros, writing to me on the 27th of November, 1879, says:—"The first rearing of *pernyi* was good, but was one month later than usual. The larvæ of the second rearing are still in the oaks, and have commenced their cocoons. I shall only collect half a crop. The bad result you have obtained is due, in my opinion, to the want of heat. The *pernyi* moths do not pair well, and do not lay fertile ova at a temperature less than 16° Centigrade (= 61° Fahr.) above freezing point. I bred *Telea polyphemus* in the open air, on the white oak (*Quercus pedonculata*), but the ants one night made a terrible slaughter of larvæ, and I only collected 190 cocoons.'

Samia Gloveri (North America).—Of this new and rare species I only had three cocoons, about the same size. They are silvery grey, and similar to those of *Samia cecropia*, but smaller; the moths, also, are very similar. The principal difference between *cecropia* and *gloveri* moths is that the bands on the wings, in *gloveri*, are white, encircled with deep black; the background, excepting the margins (which are somewhat similar to those of *cecropia*), is of a dark, rich red-brown. This short and rough description is that of the male *gloveri*, the specimen of which I have being about 5½ in.; the females were a little smaller in expanse of wings. The females, being kept in cages for the sake of reproduction, lost their colours. With my three *gloveri* cocoons I obtained a female 14th of June, which I paired on the 22nd with a *S. cecropia*. This pairing lasted a considerable

time, and on the 23rd my famale *Gloveri* laid freely 79 ova, 65 remaining in the abdomen. These ova I carefully kept and watched, hoping they might hatch, but they all turned out unfertile, like those I had obtained by the crossings of different species.

On the 3rd of July, a male *gloveri* emerged of such beauty that I sacrificed its life to have a perfect specimen, the remaining cocoon being so small that I supposed it must be a male also. But I was mistaken, for, on the 5th of July, I had a splendid female. So, had I kept the male *gloveri*, I might have had a chance of obtaining a pairing of this valuable species. I am told that the larvæ of this species are bred on gooseberry and currant bushes.

As this species is scarcely known, no other food plants are mentioned to me; but it is so closely allied to *cecropia*, that I think it would probably feed on some of the food plants of *cecropia*.

Samia Promethea.—Moths began to emerge on the 10th of July, and about ten pairings were obtained. Many of the cocoons, like some of the *cecropia* and *polyhemus*, were attached by a large parasite, the *hymenopteron*, *Ophion macrurum*. Every year this terrible *ichneumon* attacks large numbers of the three species mentioned, especially *polyhemus*. *Ophion macrurum* bites and stings like a wasp.

Actias luna (North America).—This species I have as yet, been unable to rear. On several occasions during the last three years, I had ova sent to me from America, which invariably hatched during the voyage. This year, I received two small lots of cocoons. One lot consisted of 32 cocoons, which were so small that I could not obtain a single moth. The larvæ had evidently been bred by a most inexperienced person. The second lot (seven fine cocoons) produced only male moths. Subsequently, I received a large quantity of ova, on the 20th of August, from New York. These ova were pressed in a small tin box, wrapped up in wool, and sent in a letter. Like those received previously, all hatched during the voyage, and I only had a mass of dead larvæ; they were smothered in the little box. This species, like *selene*, will feed on walnut and cherry, and also, it is said, on oak and box-elder.

Saturnia (*Hyperchiria*) *To*.—Of this brilliant species I had 20 cocoons. The first moth came out on the 7th of July, and others continued to emerge till about the 25th of July. Eight females emerged first from the 7th to the 15th: I then had three males and the rest again were females. I obtained three pairings, and must have had about 1,100 eggs, each female laying, on an average, about 350, sometimes nearly 400; they are deposited, for the most part, in large bundles. The larvæ of this species are easy to rear, and will thrive anywhere, even under glasses; but, as they grow rather slowly, it is best to keep them in a warm place, unless the larvæ should hatch early. The pairings this year took place on the 17th, 18th, and 19th of July. This species is polyphagous, and will feed well on willow, plum, oak, Indian corn, &c. When the larva is full grown, it is light green, with a lateral stripe reddish and white, and each segment is covered with tufts of green hairs, which sting like nettles.

Attacus Roylei (Himalaya Mountains).—The cocoon of this wild species is very large, it being surrounded with an envelope of thinly-spun silk; it is not rich in silk, and therefore is very inferior to *Pernyi* and *Yama-mai*. The moth is similar in shape, size, and designs on the wings to *Pernyi* and *Yama-mai*, but the colours are not so brilliant. As I stated in my last report, I obtained, in June last, large and strong moths from the 28 cocoons I had; yet, I could not detect a single pairing of this strange species, in spite of all my contrivances to arrive at a satisfactory result. Still, I had hopes that pairings of a short duration might have taken place during the nights; but, unfortunately, none of the eggs turned out fertile. From this first experiment, it would seem that this species cannot pair in captivity; but this assertion cannot be made until it has been tried again. I must state that Mr. P. H. Gosse, of Torquay, was, like myself, unsuccessful with this species.

Actias Selene (India).—As stated in one of my reports, this splendid species was reared very extensively last year, but few live cocoons could be retained for this year's rearing (1879), as most of the moths emerged during the autumn, it being a double-brooded species. The cocoons, which are closed, and poor in silk, vary in colour from silvery white to grey, and even brown. This season, with five cocoons sent to me by three different correspondents, who had bred the species last year, I succeeded in obtaining one pairing.

One of my correspondents, Herr L. Huesmann, who only had a few eggs, wrote to me (October 15th) that, with nine larvæ, he obtained eight splendid cocoons, as large as those imported from India. Three moths had already emerged, one male and two females; the latter measuring 16 centimetres. This shows, not only that the species had not degenerated, but, above all, that the larvæ were reared by a skillful and experienced entomologist. A memoiron Selene, by Herr L. Huesmann, is published in the Berlin paper, *Isis*, October 30th, 1879. This gentleman was equally successful with the rearing of the great *Attacus mylitta*, and I shall quote from his letter in my report on this latter, the largest of all the silk producers of India.

Besides the five Selene cocoons already mentioned, I had nine enormous cocoons sent to me by one of my French correspondents. These cocoons had been imported from Madras. Besides their enormous size, these cocoons are thick and rich in silk, compared with Selene cocoons of other races. I could not obtain a single moth from these cocoons during the summer, but about the middle of October, two male moths emerged. The remaining cocoons still contain large and healthy pupæ, which, in all probability, will hybernate a second time, and produce their moths in 1880.

I tried during the summer, at the end of July (of course, the word summer here is only a figure of speech), to force, by artificial heat, the emergence of the moths, but I could not succeed. With some species of Lepidoptera, when the proper time for the moth to emerge is over, it may be concluded from my experiment, that artificial heat is of no avail to force the moth to emerge out of its natural season. I tried to force, not only Selene moths, but several other species, but failed to obtain the desired result. Forcing must be resorted to some time before the natural season has arrived for the emergence of the moths, in which case some species might be obtained much earlier than usual.

Two small cases of Selene and other cocoons had also been sent to me from Ceylon, but as it was too late in the season, all the moths emerged during the voyage.

Hybrids.—Having received several communications on the subject of hybrid species, the last being from Herr L. Huesmann, I will state the little I know, and the few facts which have come under my notice.

As is well known, hybrids have been obtained by the crossing of *Smerinthus ocellatus* with *Sm. populi*; also by the crossing of the different species of *Saturnia*, *Pyri*, *Spini*, and *Carpini* (*Pavonia major*, *Pavonia media*, *Pavonia minor*).

Hybrids have also been obtained by the crossing of the oak silkworms, *Yama-mai* and *pernyi*. These hybrids are certainly very interesting to the entomologist, but what I wish to consider is, whether they have any power of reproduction; at least, in a state of captivity.

In the south of France, we have a very local species of *Papilio*, *P. alexanor*, which, although of the same shape and colour as *P. machaon*, has its upper wings very similar to those of *P. podalirius*. Might not *alexanor*, although it is a distinct and well-established species, have been originally the product of a natural crossing of *machaon* with *podalirius*? If crossings take place in a state of captivity, they may also take place in

a state of liberty, and produce those species which we find so closely allied?

Yet, what I am going to say respecting the hybrids of *Yama-mai* and *pernyi* would go against this possibility of new species being permanently obtained by natural crossings; but it is well-known that, in a state of confinement, Lepidoptera, bred from the same small stock, degenerate to such an extent that, about the third season, the ova obtained becomes unfertile, or the young larvæ too weak to live. It has been the case with several species I have tried, and I should like to hear that this was only accidental, and that the same species could be bred in confinement on a small scale, for a long succession of years, without showing any signs of degeneracy.

With hybrids, degeneracy in a state of captivity would, of course, be much greater than with natural and well-established species.

Lepidoptera, bred from the same small stock in a state of confinement, degenerate, and usually become extinct in the third year. But it must not be concluded that "consanguinity" is the cause of this. Want of space, of pure air, and proper food may probably be the only causes. In support of this, I may mention that M. V. La Perre de Roo has contributed to the "Bulletin de la Société d'Acclimatation," July, 1878, January and September, 1879, several important papers on "The pretended fatal effects of consanguineous alliances," in which the author, after twenty years' experiments on various species of animals, says that consanguinity is not a cause of degeneracy; he maintains that degeneracy through consanguinity, in the human race, as well as in all other animals, is a a popular error, unsupported by facts.

Hybrids of *Yama-mai* and *pernyi*, as far as I know, have been complete failures, respecting the reproduction of the species. A few years ago, M. Bigot, one of the best French sericulturists, obtained hybrids by crossing *Yama-mai* females, with *Pernyi* males, and *vice versa*, but these races are now extinct. Yet the larvæ and moths were fine and large. The late Mr. Andrew Murray showed me, in 1876, magnificent specimens of these hybrids, which he had obtained from M. Bigot. These hybrids, like those obtained by other entomologists, hybernated in the pupa state. Had the hybrids come into existence in a state of nature, and in warm countries, where the parent insects could live entirely in a wild state, would the said hybrids still have the power of reproduction, and would they have continued to live as distinct species? This, of course, it is impossible to answer.

M. E. Berce, author of the "Faune Entomologique Française," and other works, and who is a most experienced French entomologist, also had a hybrid, *Yama-mai pernyi*, which, I was told, had been in existence for a few years. M. Berce gave me, in Paris (during the winter, 1875, I think), some 19 cocoons of this hybrid species; they were so thin that they could hardly be called cocoons. Evidently, the insect was in the last stage of its existence, for I only obtained one female moth which paired with a male *pernyi*. The larvæ, when hatched, were entirely black, like *Pernyi*, and had nothing of the *Yama-mai*. They had returned to the type *Pernyi*, which is the stronger of the two. The other cocoons only contained dead larvæ, or dead pupæ.

At a meeting held at the Society of Arts, on the 25th April, 1879, during the discussion which followed the interesting paper read by Mr. Thomas Wardle, on "The Wild Silks of India," I heard something about another hybrid, which had been obtained in Bombay. The statement made by Mr. A. Rogers was as follows:—"A curious fact came under my notice. There was a man in Bombay, a barber, who made a most remarkable discovery with regard to Tusser silk. He showed me the produce of silk, which had been spun by a hybrid worm, produced between the common Indian Tusser worm, and what he said was the Japanese *Yama-mai*. Whether that was the case, I cannot say, but he certainly showed me two worms, which were about the size of my little finger, and he informed me that the silk produced was much freer from tannin than the indigenous Tusser found in the jungle. He showed me some specimens, and, so far as I could judge, the hybrid silk was far superior to the other. Mr. Morris assured me that this hybrid would feed on the commonest trees in the country."

Mr. Wardle, in commenting on the above statement, said he doubted if Mr. Rogers was correct, because the *Yama-mai* was a Japanese species, which was an oak-feeder, whereas the Tusser worm fed on very dissimilar food. Mr. Wardle said the Tusser cocoon contained no tannin or woody matter.

With regard to the above, I must say that the Tusser worm, like most other wild silk-producers, is essentially polyphagous, and that this year it has been bred on oak by some entomologists, and on hornbeam by Mr. P. H. Gosse.

Another hybrid between *Yama-mai* and *Pernyi* was also mentioned to us last year, but as, for some reasons, it has not yet come into the public domain, I can only quote from the creator of this wonderful hybrid, who is M. Bourdier, of Montboyer, France.

After speaking of the *Yama-mai* and the advantages enjoyed by *Pernyi* over *Yama-mai*, he thus speaks of hi *Perny-Yama*:—"This fruitful hybrid has over its parents the immense advantage of being perfectly hardy; it will resist a temperature of zero Cent. (freezing point) and will eat even dried up leaves, if they are not brittle. It provides two crops a year, if the breeder, by artificial means, hastens the emergence of the moths from the hybernating cocoons. Eggs scattered in the country will for ever people our oak forests with this silk-producer, which can hardly degenerate. A mere 'delocalisation' of a few miles, which the moths will cross over with a single stroke of their powerful wings, will be sufficient for their 'regeneracy.'" Such is the short sketch (which I I have translated freely from the French) of this hybrid, which has been denominated by M. Bourdier, *Perny-Yama de Montboyer*.

To finish with the hybrids, I may mention that, for several years, I have obtained pairings of different species, but in all such cases the ova were infertile: *Pernyi* male with *Polyphemus* female, *Cecropia* male with *Cynthia* female, several times; *Cecropia* male with *Gloveri* female; *Cecropia* male with *Polyphemus*, several times; crossings of *Attacus pyri* with *Cecropia* have proved equally fruitless.

(*To be continued.*)

NEW ZEALAND TELEGRAPHS.

It appears, from the Fifteenth Annual Report of the Commissioner of Telegraphs for New Zealand, that the revenue of the Telegraph Department for the year ended 30th June, 1879, was estimated at £76,000, but exceeded that amount by £5,435 14s. 4d. The total number of messages of all codes transmitted during the year was 1,448,943, being an increase over the previous year of 188,619, or 14 per cent. During the year, 109 miles of line, carrying 113 miles of wire, were erected, as well as 296 miles of wire on existing lines, making the total mileage in circuit on the 30th June, of line, 3,543, and wire, 8,444. The number of stations open to the public at this date was 195; of these 16 were opened during the past year, being 11 in the north island and 5 in the south island. The mileage of line maintained was 3,434 miles, at an average cost for maintenance of £5 0s. 9d. per mile. The duplex system continues to be worked with success, and is in use in circuits representing 1,461 miles of phantom wire, and has caused an absolute saving of over £20,000. The Commissioner thinks it a matter of congratulation

that New Zealand is the first colony on that side of the line which has introduced, and worked with success, this improved system of telegraphy. Experiments in the quadruplex system have been tried, and as soon as the necessary instruments arrive from England it will be put into practical use.

The demands for additional assistance at the chief stations became so pressing, that during the past year a large number of cadets, in excess of the ordinary number trained annually, were admitted. The nominal strength of the department on the 30th June, 1879, was 801, against 716 in the previous year.

GENERAL NOTES.

Lectures on Music.—A course of six lectures, on the art and science of pianoforte playing—with copious musical illustrations by the students—will be given, in connection with the National Training School for Music, in the West Theatre of the Royal Albert-hall, by Mr. Ernst Pauer, on Fridays, February 13th, 20th, and 27th, and March 5th, 12th, and 19th, commencing each day at 2.30 p.m. punctually. Founders of scholarships, and the friends whom they may bring with them, also friends of the school, will be admitted to the lectures on presenting their notices of invitation at the door.

Fires in the Metropolis.—Lord Granville made the following remarks on the better supply of water for the extinction of fires in London, in his speech in the House of Lords at the opening of Parliament on the 6th inst.:—"There is, indeed, one measure not announced in the Queen's Speech, but which, I am told, will appear in the shape of a private Bill, on which I heartily congratulate your lordships It may possibly prove to be the most useful measure of this Parliament. I called attention last Session to the miserable supply of water in the metropolis for the extinction of fire. A noble earl, who had often, without any encouragement from the Government, brought the whole subject before your lordships, announced his intention of asking your lordships to agree to a resolution on the subject. Mr. Cross, however, told us that he intended to take the matter in hand, and deprecated further discussion in this House till he could make his statement. I believe that he fulfilled his pledge, and has been successfully working on the lines of the excellent reports of the Society of Arts." The report of the Committee of the Society on the prevention of the spread of fires and the constant supply of water to the metropolis, made in the year 1874, is printed in the *Journal*, vol. xxii., p. 449.

Orange Trade.—Very large quantities of oranges and lemons are now shipped from Palermo to the United States. Each box of fruit, it appears, contains on an average about 350 oranges or lemons. The average price of a box of the former during 1878 was about 5s., free on board; that of a box of lemons about 6s. 6d. The trade in these fruits is now almost entirely in Sicilian hands. The old-established houses having suffered great losses by the hazardous character of the trade, have abandoned it to the small proprietors of orange plantations, who ship the fruit at their own risk. Eager to get rid of their produce they send it to the States in such quantities as to overstock the market, so that a box, on which the freight, duty, and commission alone will amount to a dollar or a dollar and a half, exclusive of the prime cost of the fruit and box, will often fetch no more than a dollar when sold by auction at New York or Philadelphia. The increased facilities of transport afforded by steam have proved injurious rather than beneficial to the trade. Formerly, when the trade was carried on in sailing vessels, which took 60 or 70 days to cross the Atlantic from Palermo, the export was confined to the best kinds of fruit, which alone were able to bear so protracted a voyage. Now that a steamer can accomplish the transit in three weeks or less, fruit of inferior quality is also shipped; and as a steamer can carry 10,000 or 12,000 boxes, instead of 3,000 or 4,000, which was an average cargo for a sailing vessel, the market is easily glutted, the prices not only cease to be remunerative, but the speculation is often ruinous to the shippers.—*Gardeners' Chronicle.*

Consumption of Tobacco.—A comparison of the taxation of the chief nations of the world for the consumption of tobacco has been published in the *Imperial Statistics of Germany*. Of the countries where the sale is a Government monopoly, France last year stood first, the gross duty, with profits, amounting to 7s. 1½d. per head of the population annually, the net revenue from the article being 5s. 8½d. per head. In Austria the gross was 5s. 5¾d., the net, 3s. 5d; in Hungary, the gross 3s. 3½d., the net 1s. 7d.; in Italy, the gross 3s. 11d., and the net 2s. 8½d. In Great Britain, the duty and licenses brought in 4s. 10¾d. per head of the population for the year, and in the United States 4s. 4½d. In Germany, on the other hand, where the duty was very light, the average was no more than 7¾d. per head of the population. The new tariff which has been passed this year will make the next return for Germany much heavier. The value of the tobacco consumed in Germany in 1878 is calculated to have been 353 million marks, or £17,650,000 sterling, the total return to the revenue being 26,383,966 marks, or £1,319,198. The quantity consumed in that empire in the year is stated at 2,196,000 cwt., or rather more than 100,000 tons. Of this quantity 582,600 cwt., or upwards of 29,000 tons were consumed in the form of cigars. Reckoning a hundred cigars to a pound in weight, the number of cigars consumed in Germany in 1878 would be upwards of seven thousand millions, which would give two cigars a day all the year round to ten million smokers. But besides cigars the Germans smoked in the year 1,327,200 cwt., or upwards of 60,000 tons of tobacco more or less manufactured. In the form of snuff they took 160,600 cwt., or 8,000 tons in the course of the year, while in the way of chewing tobacco they limited themselves to the moderate quantity of 14,200 cwt., or about 700 tons. Rather more than one-third of the total weight of tobacco consumed was grown within the limits of Germany, the quantity so produced in 1878 being 596,776 cwt., while the imports amounted to 1,768,855 cwt. of tobacco leaves, 4,827 cwt. of roll tobacco, 14,170 cwt. of cigars, 8,321 cwt. of stems for snuffs, 513 cwt. of snuff, and 101 cwt. of chewing tobacco. The total area of land engaged in growing the plant in 1878 was 18,016 hectares, or about 44,520 acres. Two-thirds of the quantity was grown in Rhenish Bavaria, Baden, South Hesse, and Alsace-Lorraine, in which districts 11,623 hectares were employed in the cultivation of the plant.

MEETINGS OF THE SOCIETY

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

February 18.—"The Euphrates Valley Railway." By W. P. Andrew. Field-Marshal Lord Strathnairn, G.C.B., G.C.S.I., will preside.

February 25.—"The Noxious Gases Bill." By E. K. Muspratt, F.C.S.

March 3.—"The History of Musical Pitch." By Alexander J. Ellis, F.R.S. Dr. Pole, F.R.S., will preside.

March 10.—"Recent Advances in the Production of Lambeth Art Pottery." By John Sparkes. Sir Philip Cunliffe Owen, C.B., K.C.M.G., will preside.

March 17.—"The Art of the Silversmith." By W. Herbert Singer.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

April 14.—"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

February 17.—"The Principal Causes of Disease in Tropical Countries, Scientifically Considered." By

ALEXANDER WILLIAM MITCHINSON. Dr. RICHARDSON, F.R.S., will preside.

FEBRUARY 24.—"Views of Colonization." By WILLIAM FORSTER, of New South Wales. Sir CHARLES NICHOLSON, Bart., will preside.

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MARCH 11.—"Balmain's Luminous Paint." By C. W. HEATON, F.C S. Professor H. C. ROSCOE, F.R.S., will preside.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S.

LECTURE III.—FEBRUARY 16.

Vulcanisation of India-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on India-rubber.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and ONE friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 16TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture III.)

Royal United Service Institution, Whitehall-yard, S.W., 8½ p.m. 1. Major J. M. Moody, "Sadler's Double Rudder and Moveable Propeller Steamship." 2. Mr. P. Adie, "Adie's Telemeter."

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. W. L. Huskinson's paper, "The Present Depression in English Agriculture: its Real and Assumed Causes."

Medical, 11, Chandos-street, W., 8½ p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Paper by the Rev. C. Engström.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Monier Williams, "Indian Religious Life."

TUESDAY, FEB. 17TH.....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. Alexander William Mitchinson, "The Principal Causes of Disease in Tropical Countries, Scientifically Considered."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture VI.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Adjourned Discussion on "Iron and Steel at Low Temperatures," and, time permitting, Mr. W. H. Delano, "The Use of Asphalt and Bitumen in Engineering."

Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Mr. Thomas A. Welton, "Certain Changes in the English Rates of Mortality."

Pathological, 53, Berners-street, Oxford-street, W., 8¼ p.m.

Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 18TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. W. P. Andrew, "The Euphrates Valley Railway."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Lieut. Alfred Carpenter, "Typhoons in China, 1877 and 1878." 2. Mr. Robert H. Scott, "Note on the Reports of Wind Force and Velocity during the Tay Bridge Storm, December 28th, 1879." 3. Mr. William Marriott, "The Frost of December, 1879, over the British Isles." 4. Captain William Watson, "Thermometric Observations on Board the Cunard R.M.S.S. *Algeria*."

Public Analysts, Burlington-house, W., 8 p.m. 1. Dr. J. Muter, "The Estimation of Cane Sugar in Milk." 2. Mr. A. Wynter Blyth, "A New Method of Taking the Specific Gravity of Solid Fats at Ordinary Temperatures." 3. Mr. J. West Knights, "The Action of Alum in Bread-making." 4. Mr. F. Maxwell Lyte, "Blowpipe Assays of Silver Lead." 5. Mr. F. B Perkins, "The Persistent Occurrence of Starch." 6. Mr. H. Macagno, "The Tannin of Sumach Leaves," and "A Series of Analyses of Air."

Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. T. G. Pinches, "Terra Cotta Tablets found in Assyria and Babylonia." 2. Mr. H. Syer Cuming, "Portrait of Henry VI. in Eye Church, Suffolk."

THURSDAY, FEB. 19TH...Royal, Burlington-house, W., 8½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Aitchison, "Flora of the Kurum Valley, Afghanistan." 2. Dr. A. Günther, "The Presence of a Phosphorescent Organ in Fishes." 3. Mr. J. Britten, "Remarks on Specimens of Myrmecodia." 4. Mr. J. Jenner Weir, "A Three-horned Prongbuck."

Chemical, Burlington-house, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Lecture by Sir Travers Twiss.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture IV.)

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m. Mr. J. Cadett, "Brilliancy in Lighting," specially with reference to the use and misuse of the Lime Light. Illustrated by experiments.

Royal Historical, 22, Albemarle-street, W., 8 p.m. 1. Mr. Cornelius Walford, "An Outline History of the Hanseatic League, more particularly in its Bearings upon English Commerce." 2. Rev. A. H. Wratislaw, "Dubravius, Bishop of Olmutz (1542-1553)."

Numismatic, 4, St. Martin's-place, W., 7 p.m.

Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. James Love, "The Fracture of Cast Iron."

FRIDAY, FEB. 20TH...Royal United Service Inst., Whitehall-yard, S.W., 3 p.m. Commander V. Lovett Cameron, "His Travels in Mesopotamia, especially with Reference to the Proposed Euphrates Valley Railway."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Rev. H. R. Haweis, "Old Violins."

Philological, University College, W.C., 8 p.m. Mr. Russell Martineau, "The Rhæto-Romanic Dialect, Part II."

Geological, Burlington-house, W., 1 p.m. Annual Meeting.

Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Gulstonian Lecture.) Dr. Gower, "Epilepsy." (Lecture I.)

SATURDAY, FEB. 21ST...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Ernst Pauer, "Joseph Haydn" (with Musical Illustrations).

Supplement to the Journal of the Society of Arts, Feb. 20, 1880.

TO ILLUSTRATE Mr W. P. ANDREW'S PAPER ON THE EUPHRATES VALLEY RAILWAY.



JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, FEBRUARY 20, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

UNION OF INSTITUTIONS.

The following Institution has been received into Union since the last announcement :—

School of Science and Art, Corporation-street, Newcastle-on-Tyne.

CANTOR LECTURES.

The first three lectures of the Second Course of Cantor Lectures, "On the Manufacture of India-rubber and Gutta-percha," were delivered by THOMAS BOLAS, F.C.S., on Mondays, February 2, 9, and 16. The Lectures will be printed in the *Journal* during the summer recess.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday, Feb. 12th, 1880; HENRY DOULTON, Esq., Member of the Council, in the chair.

The paper read was—

GAS FURNACES AND KILNS FOR BURNING POTTERY.

By Herbert Guthrie, C.E.

It is with some trepidation I appear before you this evening. In doing so, my first duty is to acknowledge the kind assistance rendered me by several friends in the preparation of my paper on "Gas Furnaces and Kilns for Burning Pottery."

I hope I have accumulated sufficient material to render the subject interesting to you, though I do not aim at a complete or exhaustive essay, as such an effort would require a much longer time than I can presume to occupy. I shall, first, ask your attention to the manufacture of heavy goods, such as bricks and tiles; noticing the differences between the two principal modes of manufacture—"plastic," and "granular," or semi-dry, as it is sometimes called—so far as they affect kilning. After which, I propose to examine the process of kilning, and, as far as will be practicable to-night, analyse the thermal expenditure of the two representative kinds of kilning, known as continuous and non-continuous.

Next, I propose to compare the merits of solid as against gaseous fuel, and the modes of applying them; passing on from this to the differences between firing goods of the heavy description without protection, and light goods with protection—namely, those burnt in seggars; and, lastly, since the same arguments apply to lime-burning, I shall ask your attention to that topic, for a few moments only, before closing.

This is a large programme for one reading, and I fear I shall be able to do it but scanty justice. I shall not, however, depart from the sphere of kilning proper, my chief aim being the indication of the probable limit of economy, whilst investigating the possible advancement in the perfection of work and the economy of fuel.

My attention was first particularly drawn to this subject when engaged in engineering works on the Tyne connected with fire-brick making, and, from impromptu experiments I then made, I was convinced that fire-clays could be formed into bricks by the dry process. Like many others who suddenly think they are very clever, and have made a discovery, I took out several patents, and, as you will readily suppose, I had to pay dearly for the information I obtained. Suffice it to say, I gather that, where a large body of such material has to be treated and formed into one solid mass—such as a brick—the essential conditions to be aimed at are the forming of a vacuum, the supply of a lubricant, and an agitating and reciprocatory motion during consolidation.

The forming of a vacuum has been attempted many and many a time, and often with tolerable success. There have been patents obtained for the introduction of a jet, or jets, of steam into the charge of granular material immediately before compression. The idea is sound, if the necessary mechanical conditions can be brought about as quickly as the steam condenses upon the granules of cold clay. But this seems practically impossible, for the steam condenses much more rapidly than the machine can close the mould and prevent air rushing in. So quickly, in fact, does the condensation occur, that it all lodges among the first few granules it meets with. Consequently, when the brick is relieved of the pressure, wet patches are seen, which entirely destroy the homogeneity of the mass. Others have mixed the materials with hot water, and, by so creating a partially aqueous vapour, have met with better success. A further step upon this is the heating of the mass, slightly, in a steam-jacketed cylinder, or mixing mill, causing a more aqueous vapour to rise, and preventing too quick condensation; thus still more success has been realised. And it is in this direction, I think, with two other points, that a greater degree of perfection will obtain. There is a limit, though, to the amount of heat we can advantageously apply in this way; for, if we get the material to a full steam heat in order to create a perfectly aqueous vapour, and entirely expel the air, we are no better off than when we applied no heat at all, just because we have brought about that condition of things which renders the steam as non-condensable as the air, and so have only substituted one non-condensable element for another equally objectionable. It is true, this aqueous vapour may, and does, condense under heavy pressure. This condensation, however, under such conditions, is only momentary, and, if we follow it to the next step, we see at once what must happen. Here is a mass of matter, at boiling heat, compressed along with, at least, its own bulk of a vapour whose permanent condensation necessitates a large extraction of heat. If the whole of the charge is at boiling point, we have

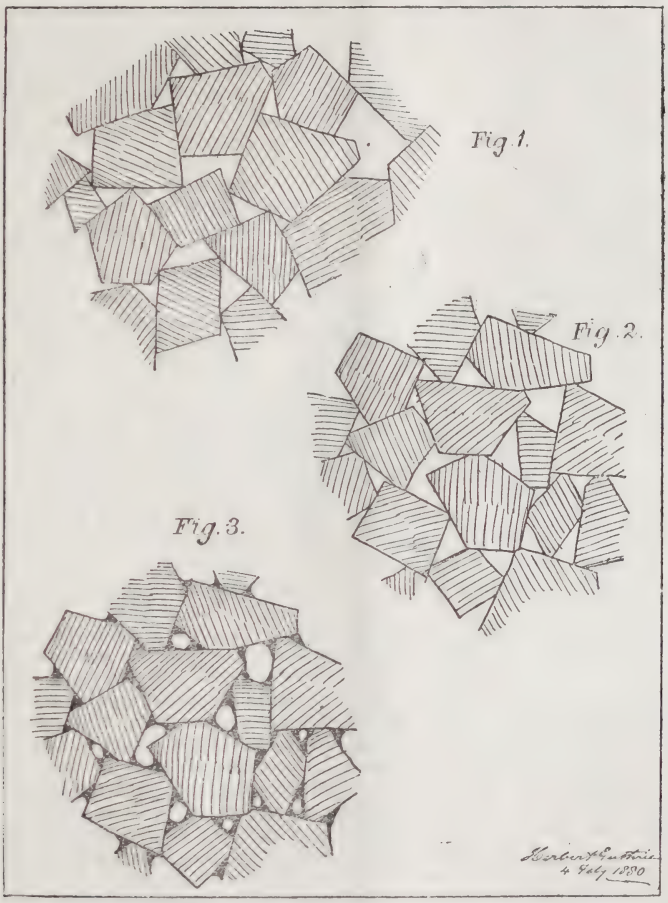
nothing to absorb that heat; consequently, as soon as the pressure is taken off, we have much the same result as before, with the additional drawback of the expense of the apparatus. So, as the effect of the moulding with steam will be similar to that of moulding with air, let us follow that for a few moments. Supposing we have a charge of loose granular clay in a box, containing 100 cubic inches, the amount of solid matter would be about 40 per cent.; the brick, or tile, when made, would be as nearly as possible 50 per cent. of the original amount. We thus have 60 cubic inches of air to squeeze into 10 cubic inches. Now, this reduction of bulk would create a pressure of about 75 lbs. per square inch, without allowing for increase of temperature; and, after allowing for increase of temperature, presuming we start at 60°, we have a pressure of about 160 lbs., or 11 atmospheres. But this, of course, is supposing no air or heat is lost, which is not the case. A great loss of air occurs between the loosely-fitting mould and the dies, and of heat to the clay and machinery, neither of which can be even approximately estimated. But, for argument's sake, suppose we say that one-tenth of this amount remains, can we hope to solidify raw clays sufficiently to stand even 16 lbs. per square inch, equalling, in an ordinary brick, a total tendency to rupture of 640 lbs.? I cannot believe that anything like this is realised. To go through these figures, however, serves to show what great difficulties there are to contend with, and what little hope we may have of overcoming them by any merely mechanical arrangement. It is true, that if we allow the pressure to remain upon the article for a considerable length of time, the air will gradually dissipate, and its evil effect be overcome; and that the duration of pressure might be considerably shortened if the mould could be partially stripped off without removing much of the pressure, so as to expose part of the article to the atmosphere, as this would allow the air to escape, and the pressure could then be gradually removed without fear; but this, again, would take time, for the then very close proximity of the granules would offer such increased resistance to the passage of air that we could not expect anything but rupture without dwelling upon it an impracticable length of time. It is clear, then, since we cannot afford the operation to occupy much time, that, if it is to be done at all, it must be in a permanently condensable atmosphere, and to do this with an aqueous vapour, there must be sufficient margin in the temperature of the clay and its moisture to absorb all the latent heat of the steam in the charge. So, if we find this out, we know the maximum heat at which we dare introduce the clay into the mould. Now, since the finished article has space in it, unoccupied by solid matter, equal to 10 cubic inches, we may allow that amount of air to go in without detriment to the result. There will be a double advantage in doing this; for, besides reducing the quantity of steam to be condensed, it brings about a condition by which we are able to use an aqueous vapour at a temperature much below boiling point. An atmosphere containing 50 cubic inches of steam and 10 of air can be obtained by a temperature of 200°. The latent heat here to be absorbed is only ·966 thermal units. Supposing, then, we heat the whole charge up to 200°, what margin have we for the absorption of this ·966 units? To raise 40 cubic inches of clay—which equals nearly 2¼ lbs.—from 200° to 212° would require 5·4 thermal units; and to heat the water, equalling about ¼ lb., would require ·75 thermal units, making, in all, 6·15 thermal units, or about seven times the reserve required. Since the whole object, however, is to perform the operation quickly, we must have a good margin. The clay is a fixed material, and is limited in its immediate influence, to the amount of surface presented to the vapour surrounding it. But the water alone is almost sufficient to do the work; therefore, I think, we may safely reckon that the clay can do the rest. The mass, when finished, will not have been raised 2°.

It might be said at this stage, that the expense of heating the materials to this extent would be considerable, and a serious item in the cost of manufacture in common articles like bricks. If we look a little further, however, I think it can be shown that it is not so. The heat imparted can be made to do its full share of the work of drawing off the moisture, if surface condensation be prevented by placing the articles in a warm atmosphere. The amount of thermal energy available in the goods at this point is 90·5 units, being the amount required to raise 40 cubic inches of clay from 60° to 200°. We have supposed 10 per cent. of moisture to be in the clay, equalling about ¼ lb. Now, to evaporate ¼ lb. of water, we require 241 thermal units. We have 90 units; therefore, $\frac{90}{241}$ ths, or rather more than a third of the moisture, will be driven off by the heat remaining in the goods at completion.

The next point to be noticed is the lubricant employed for enabling the granules of the charge to slip upon one another, and get into close contact to enable them to poke their noses (as it were) between their neighbours, and into all the little crannies they can find, and not stick wherever they first touch as when no lubricant is employed. This is a point seldom, I think, fully considered, though often ignorantly allowed for, from the simple fact that we know by experience that articles made from almost dry material are never so sound and dense as those made with an amount of moisture. Oil would, probably, be the best lubricant, simply as such; but, for ordinary heavy goods, it would be too expensive, and for the better class of goods it would not do; in many cases, on account of its effect upon their colour. But water is a good lubricant; it is cheap, and it is contained to a large extent naturally in most clays, and to some extent in all. Further, besides water being a lubricant, it is the source of our aqueous atmosphere, and, therefore, answers the double purpose.

The third point essential for a good and sound result, and the perfecting of the corners and surface, is the movement of the granules about one another in a way that will assist the lubricant in its office; and this, it seems to me, can be best done by causing a reciprocatory movement of the dies or mould during pressure, for such a movement, while it assists the lubricant to bring the particles together throughout the mass, rubs the convex and angular corners off the granules on the surface and forms a polished and compact face. It has, also, the additional, and perhaps the more important, feature still, of improving and strengthening the corners; as you will see, if you follow the process

through in your minds. The friction of the mould, when travelling in one direction, with the charge under pressure, drags along with it, with intensified power, the granules close to the surface; grinding off the tips of those granules, and sweeping the dust into the interstices of the charge and the corners of the mould at one side, and, by reversing the motion into the corners, on the opposite side, and so making the surface and edges more dense, smooth, and strong than the body of the article itself; whereas, without this movement, the reverse is the case. But, in spite of all these arrangements, we cannot hope to bring the particles together with anything like the same amount of contact, or with anything like the same amount of soundness in the raw condition, as by the plastic process. I am not forgetting the success this process has met with in button-making, and even larger articles, such as tiles. I must remind you that I am dealing, at the present moment, with the still larger class of articles, such as bricks, heavy tiles, and terra cotta, where the circumstances are materially altered, the expense of manufacture being small compared with the weight of the materials. In the former case, the expenditure of a little heat and a vast amount of mechanical force would be but a small matter; but, in the latter case, it would make all the difference between success and failure, from a commercial point, however perfect the articles when finished. The expense of treating large bodies of clay as has been suggested becomes an item in cost of plant, but the thermal expenditure by such a mode of treatment need not be lost, for, as I have already stated, it is made to do double duty—first, serving to assist the solidifying of the mass, and afterwards to carry off its due share of moisture; so that an argument against such a process, as costing so much additional for heating the material, would not stand, the expenditure being no more than is now experienced. I may just state that my experience has confirmed me in the opinions



here set forth, as I have always found the best bricks made where warm materials have been used. But I have not yet seen one process having all the points provided for. It is not my intention, however, to come to general conclusions as to which process is best, as the merits of either must be considered in reference to the particular material to be manufactured, my object being only to point out certain items, and trace their influence upon the thermal expenditure throughout the whole process of manufacture.

I will now pass on to kilning—including, of course, the drying stage, for that really belongs to it in our present inquiry—and endeavour to discuss

the advantages and disadvantages of the granular and plastic systems, both as to result in quality and thermal expenditure. The general experience is that the granular system requires a greater expenditure of fuel than the plastic. Now, why should this be? We have nothing like the same amount of moisture to drive out. We have, generally, more material pressed into a given space, which proves the superiority in density; and in spite of these proofs, practice shows we spend more fuel in burning than is consumed by goods made plastic, and, as a rule, get a worse result. I account for it in this way. Bricks made by the wet or plastic process contain so much moisture, that is to say, are so well supplied with lubricating matter that the particles slip upon one another with very great ease. Now, with the constant agitation clay experiences while under the process of pugging and moulding, every movement of the granules upon one another tends to get them more compact; and, when two flat surfaces get near to one another, they are, by the influence of capillary attraction, brought into close surface-to-surface contact, and, by the same force, are held in that position with great tenacity.

I should imagine the final settling down of such a mass of particles to form some such arrangement as shown in Fig. 1. (See previous page.) Hence, though the finished article may be very porous, it is, at the same time, very strong, owing to the amount of surface-connection between the granules; which not only accounts for the superior strength of the goods, when in the raw state, over those made by the granular process, but also for their superiority over that class of goods generally.

And now, to turn to the so-called dry process, let us see what arrangement the granules are likely to take up in relation to each other, and note the differences between this and that of the plastic process. I should think the granules in this case would come together in quite a promiscuous way, and lie together with their corners digging into one another at all angles and positions imaginable, something like my next sketch, Fig. 2.

Now, if this is so, it at once accounts for the weakness of the article; for, it is evident, granules coming together thus have nothing like the same amount of surface-connection with one another as was shown in the former case. Had it been possible to obtain microscopical sections of articles in this state, I do not think we should find our drawings very different. Even if we examined the articles when burnt, supposing both kinds to be burnt at the ordinary temperature that would make sound plastic goods, I think we should find very little alteration in the arrangement of the granules. But, to make granular moulded goods sound, we must subject them to a vitrifying heat; for ,so soon as vitrification sets in, the corners of the granules begin to melt, and, at the same instant, the capillary forces have an opportunity of slowly acting upon the soft matter surrounding each granule; and, although these granules are, perhaps, not sufficiently free to turn about and assume an arrangement similar to that of the plastic system, they, nevertheless, gain surface contact by the gradual flattening of the corners and the partly melted matter clinging about the points of contact, as shown in the sketch, Fig. 3, by which means the surface contact can be made as great as by the other process. But, to do this, we must have properties in the clay that are not always found, and, in fact, the less pure surface clays used in the manufacture of common bricks, tiles, and pottery, cannot very easily be brought to this point without great risk of a large portion being spoilt by distortion.

I will now pass on to the consideration of the thermal expenditure in kilning, which properly comes under four heads:—

Firstly, that of driving off the very apparent moisture, called "Drying."

Secondly, that of driving off the remaining portion of loose moisture, called "Steaming."

Thirdly, that of driving off the fixed or combined moisture, called "Calcining," and generally included under the last-named head of "Steaming."

And fourthly, that of bringing about a more or less state of vitrification, called "Burning,"

In the plastic process, the whole four heads have to be taken separately into account; but in the granular process they may be considered as only three, the drying and steaming being merged into one stage. For while, by the wet process, the goods have to be stoved or dried on floors before being put into the kiln, by the granular, they may be placed at once in the kiln for steaming.

Referring to the table, the totals show the expenditure of thermal units and fuel throughout the process of kilning, by the two different systems of "thorough drying" prior to being placed in the kiln, as is compulsorily adopted by those using ordinary kilns and "partial drying," as is often, though not always, adopted by those using continuous or other special kilns. I will ask you to notice a conclusion we may fairly draw from the first part of this table, which may be of some importance; you will see more by the latter process that 769 more thermal units are required than by the former. The reason of this is not far to seek, the whole difference being accounted for by the fact that five parts of the water have to be heated a second time in the latter case and not in the former. It may be noticed that the figures shown for the drying process are large. Perhaps so. You must remember, however, that they do not represent the actual fuel consumed, but the equivalent of work done; and, as I had only one object in view when compiling them (so far as the drying is concerned), and as the actual practice would not in any way interfere with the proportion, I preferred keeping to the actual thermal equivalent of work done rather than speculate upon the greatly varying practice of manufacture, whether from the expenditure of fuel, or the utilising of natural advantages, such as sun-drying and draught of air, or any of the proportions of both together. I say, whatever may be spent in this direction, the fact remains the same, viz., that, if goods have to be placed specially for drying, either on a flat, or in hacks or stoves, it is dead loss to put them in a kiln before being dried to the fullest extent they are capable of in that position. Certainly, in some cases, the interest on the cost of extra drying accommodation will counterbalance this; but, in most cases, a very short calculation will establish the maxim, "If you dry at all, dry thoroughly." Having shown this, we may strike out the drying process, and consider the remainder independently. Doing this, we find

TABLE showing Analysis of Expenditure of Fuel in the Manufacture of Heavy Clay Goods, 100 lbs. of Prepared Clay containing 37 lbs. of Water, loose and combined.

Progress of 100 lbs. of prepared Clay through the several stages.	If thoroughly dried.				If partially dried.			
	Thermal units per 100 lbs.		Cwts. per 1,000 bricks.		Thermal units per 100 lbs.		Cwts. per 1,000 bricks.	
At 6,000 thermal units per lb. of fuel.								
Drying—								
To raising 63 lbs. clay from 50° to 150° Fahr.	1,260·0		26·1		1,260·0		26·1	
To raising 37 lbs. water ,, ,,	3,700·0		2 20·7		3,700·0		2 20·7	
To evaporating 29 and 24 lbs. water respectively	28,014·0		5 0 21·0		23,184·0		4 1 4·8	
		32,974·0		6 0 11·9		28,144·0		5 0 23·7
Steaming—								
To raising 63 lbs. clay from 60° to 212° Fahr.	1,915·2		1 11·7		1,915·2		1 11·7	
To raising 8 and 13 lbs. water ,, ,,	1,216·0		*e* 25·2		1,976·0		*g* 1 12·1	
To evaporating 4 and 9 lbs. water respectively	3,864·0		*f* 2 24·1		8,694·0		*h* 1 2 12·3	
		6,995·2		1 1 5·1		12,585·2		2 1 9·0
Calcining—								
To raising 62 lbs. clay from 212° to 700° Fahr.	6,148·8		*a* 1 0 15·5		6,148·8		1 0 15·5	
To raising 4 lbs. water ,, ,,	1,952·0		*b* 1 12·5		1,952·0		1 12·5	
To evaporating 4 lbs. water	3,864·0		2 24·1		3,864·0		2 24·1	
		11,964·8		2 0 24·1		11,964·8		2 0 24·1
Difference, 760 thermal units = 15·76 lbs. of fuel		51,934·0		9 2 13·1		52,694·0		9 3 0·9
Deducting the drying		32,974·0		6 0 11·9		28,144·0		5 0 23·7
		18,960·0		3 2 1·2				4 2 5·2
At 5,560 thermal units per lb.								
Burning—								
To raising 63 lbs. clay from 700° to 1,700° + 100 per cent. of waste	25,200·0	25,200·0	*c*	5 0 10·0				5 0 10·0
Total spent in common kilns		44,160·0		8 2 11·2				9 2 15·2
Amount wasted and recoverable = $\frac{2}{5}a + \frac{2}{5}b + c$		28,440·3		5 2 21·3				5 2 21·3
Total spent in good continuous kilns		15,719·7		2 3 17·9	$\left\{ \begin{array}{l} -(\frac{1}{3}e + \frac{1}{3}f) = \\ -\quad 1\quad 7{\cdot}1 = 2\ 2\ 10{\cdot}8 \end{array} \right.$			3 3 21·9
At 5,000 thermal units per lb.								
Or again for more refractory goods		18,960·0		3 2 1·2			$-(\frac{1}{3}g + \frac{1}{2}h) =$	2 17·5
To raising 63 lbs. clay from 700° to 2,500° + 150 per cent. of waste		56,700·0	*d*	12 2 11·3				3 1 4·4
Total spent in common kilns		75,660·0		16 0 12·5				
Amount wasted and recoverable $\frac{2}{5}a + \frac{2}{5}b + (d - 20$ per cent.)		48,600·3		10 2 20·3				
Total spent in good continuous kilns		27,959·7		5 1 20·2	— 1 7·1 = 5 0 13·1			

that ordinary plastic-made bricks of common clay require 8 cwt. 2 qr. 11·2 lbs. of fuel per 1,000 to burn in an ordinary open kiln, calculating 3½ tons to the 1,000; and this is exactly what we find in practice with the common clays and kilns of the Lancashire district. This, however, is universally acknowledged to be a wasteful way of burning; knowing which, I have made this analysis to see how much can (under the most perfect system) be utilised, and how much is necessarily lost in the process.

Firstly, then, the whole of the fuel expended in raising the moisture and water of combination to the evaporating point is inevitably lost; and, secondly, the whole of the fuel used to supply the heat absorbed by becoming latent in the steam of this water is also necessarily lost. These two items, by the thorough drying system, amount to 2 qrs. 20·2 lbs., and 1 cwt. 1 qr. 2 lbs. respectively, making a total of 2 cwt. 0 qrs. 2 lbs. for the removal of the water, the further item of 6 cwt. 2 qrs. 9 lbs. being required solely for raising the clay to the necessary heat. Here, then, we have a total expenditure of 8 cwt. 2 qrs. 11·2 lbs. of fuel per 1,000 of common bricks, a result which, as I have already remarked, is experienced in the Lancashire district in what is known as open kilning.

I have said that all items included in the 2 cwt. 2 lbs., used in expelling the water, are lost, but it is not so with the other and larger part. In the first case, the heat is actually carried away; in the second, it is still there when we have done with it, and can, with specially constructed kilns, be utilised to a very great extent. In the next item, I have endeavoured to show the amount we might, and do, recover in these special kilns. In re-using a heat, we must always remember its value has to be discounted, just as we discount the actual thermal power of coal, and estimate its effective power at from half to two-thirds. There is, firstly, the item of ashes; secondly, the item of air of consumption; and, thirdly, that of conduction and radiation. The first two items, in re-using a heat, do not occur; therefore, in this condition, it is of more value than as solid coal. Loss by radiation and conduction, however, must be allowed for, and, in the item of burning common goods, I estimate the increased value is just counterbalanced by the further loss in conduction and radiation. I do not suppose, either, that more than two-fifths of the items *a* and *b* can be utilised; nevertheless, out of 33,264 units of heat in the goods at completion, 28,440 can be utilised; or, out of 6 cwt. 2 qrs. 9 lbs. of fuel, we can use an equivalent of 5 cwt. 10 lbs., and bring the total expenditure from 8 cwt. 2 qrs. 11·2 lbs. to only 2 cwt. 3 qrs. 17·9 lbs, results closely agreeing with the practice at Mr. Bridge's works at Burscough.

To carry this still further, as would be the case with the treating of more refractory goods, we must allow, in obtaining the higher heat, a larger discount in the effective power of the fuel; for, it is evident, the greater the difference between the internal and external temperatures, the greater is the amount of loss by conduction and radiation. I have, therefore, as you will see, estimated the effective power of small coal, up to and including the calcining stage, at 6,000 thermal units per lb.; for the burning of common goods, at 5,500 thermal units per lb.; and, for the burning of the more refractory goods, at 5,000 thermal units per lb. I have further estimated that about 100 per cent. of the heat required to burn the common goods goes up the chimney, and 150 per cent. is thus lost in burning the more refractory ware. The diagram, which I will come to presently, will show why I have taken these figures.

Here, then, with open firing, we have a total expenditure of 16 cwt. 12·5 lbs. of fuel in burning 3½ tons of fire-clay goods. With this higher heat, though, we must allow an extra discount on its effective power, for the same reason that we allowed an extra discount on the effective power of the coal. This I have put at 20 per cent., showing the total spent in a continuous kiln, when treating this kind of goods, to be 5 cwt. 1 qr. 20·2 lbs.; figures very near to the practice of the Cattybrook Company, near Bristol, and exactly the same proportion between the former and present expenditure.

Referring to the diagram (p. 241), the perpendicular height is scaled to degrees of Fahrenheit as well as feet, and the horizontal to feet only. The space between the left hand end and the intermediate perpendicular line represents the extent of an ordinary kiln, and the total length represents that portion of a continuous kiln occupied by the progressing part of the heat. The firing is supposed to take place at the extreme left, the colours representing the different stages, as indicated in the table; the curved lines showing the temperature at any given point. The first division at the bottom shows the steaming stage. The next indicates the calcining stage. The division above that again, the first burning stage; and the two upper divisions, the burning stage of the more refractory goods. And now I can explain why I allowed 100 per cent. as wasted up the chimney of a kiln burning common goods, and 150 per cent. in a kiln burning the more refractory goods.

If we test a continuous kiln, we shall find the temperatures not very far from those indicated in the diagram by the curved line; therefore, if we calculate the area of the burning stage beyond the intermediate perpendicular line and the end, and enclosed between the curved line and the exit temperature line, we find that amount of heat utilised, which must be the amount that would otherwise have gone up the chimney. The deduction for loss by conduction and radiation, however, has not been made; lines, therefore, showing the actual temperature, would be below these. In my calculations so far, I have supposed the temperature of the exit gases to be 500°. This, however, though a fair estimate for a steam-boiler furnace, is found to be much higher than necessary for a continuous kiln of good construction. At the Cattybrook Company's works, 180° is found sufficient to maintain a good draught. We may, therefore, make a further little modification in our calculations, and reckon that part of the items *e* and *f* are carried off by this spare heat, reducing the exit temperature to between 200° and 300°, and the fuel expenditure to the amounts shown by the final figures in the table.

And now, while you have these figures in your minds, allow me to draw your attention for a few moments to the matter of cost in kilning.

We hear, occasionally, of individuals achieving

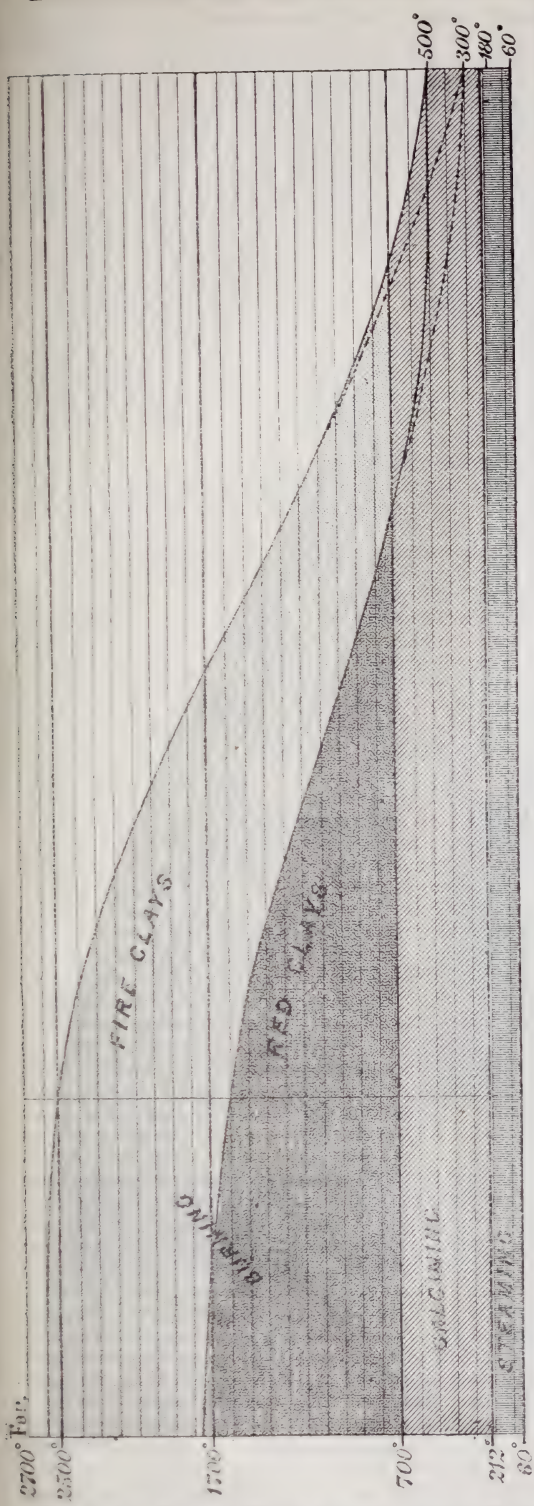


Diagram of Thermal Units expended in the Manufacture of Heavy Clay Goods.—Total Length, 50 Feet.

wonderful results, such as the burning of damp, semi-dry made bricks for 3d. per 1,000. Now, if the figures I have put before you are at all near the truth, how can we reconcile such reports with facts? We may take the second column of the table to fairly represent the case of semi-dry kilning, ignoring the first item of drying, and here we find, after making all allowances possible, that not less than 3 cwt. 1 qr. 4 lbs. of fuel is required to do the work. But, supposing we do make a little reduction, on the argument that we may cool the draught in the chimney still further, and call it 3 cwt. In the middle of the coal fields of Lancashire (and I do not think that district is any exception to the rule, unless it be that of cheapness, quality taken into account), we do not, as a rule, hope to buy coals for less than 5s. per ton, delivered at the kiln side. This, then, at 5s. per ton, and 3 cwt. per 1,000, represents a cost of 9d. per 1,000.

What can we think then, when we hear assertions of this kind, just broadly stated as though there were no extraordinary circumstances about the case, except that of their own ability of manipulation. I do not say that even 9d., cannot, under any circumstances, be encroached upon. But I do say, that when extraordinary circumstances occur, such as an unusually mild material, an unusually cheap fuel, or an unusual amount of drying or stoving brings about these apparently extraordinary results, it is hardly the truth to state the one without the other.

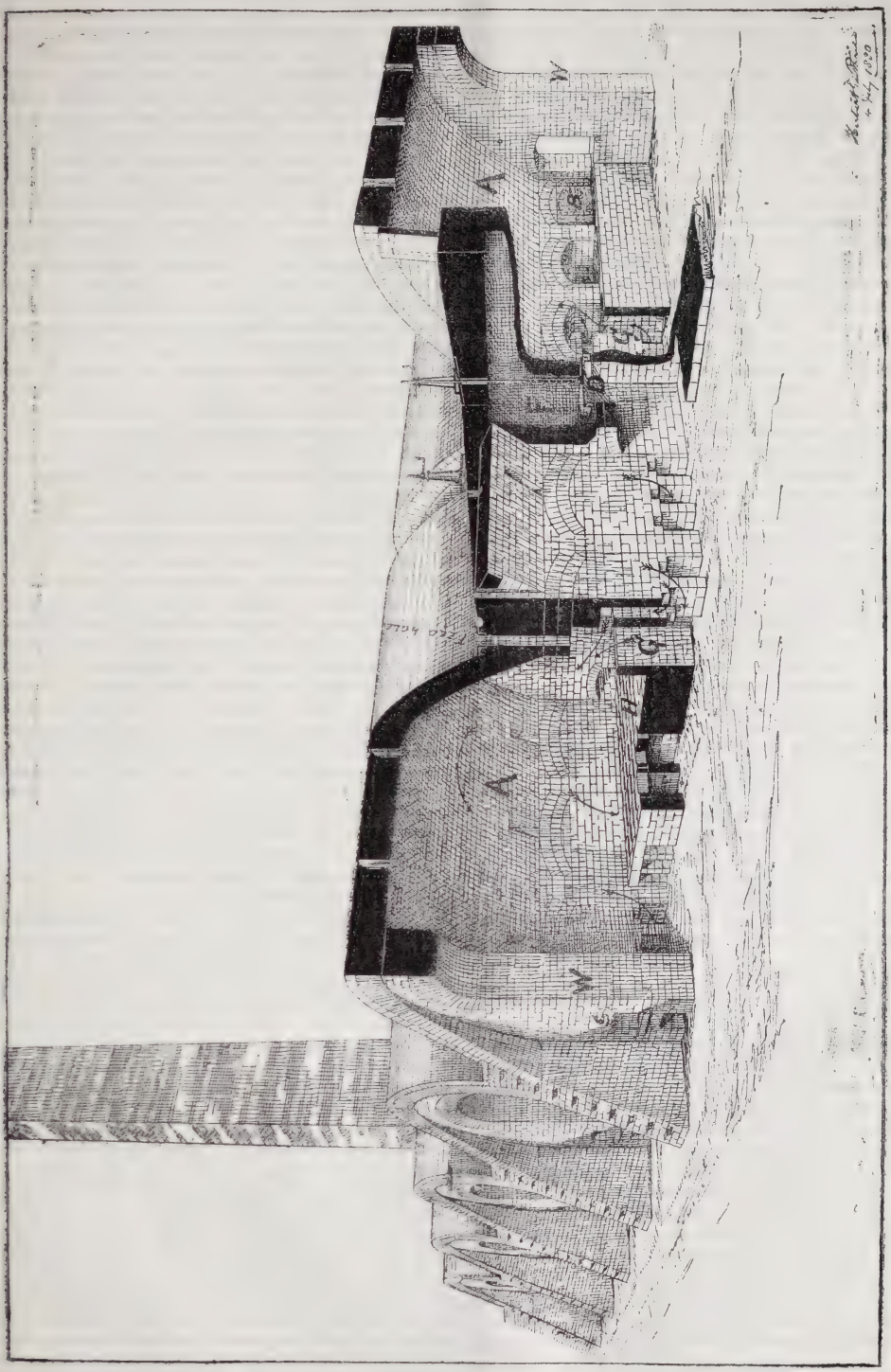
To return to the subject of the table and diagram, you will, perhaps, notice that the amount of moisture is large. So it is, as large as any case I know of. But whether it is large or small to begin with, it makes no difference to the final results; for, as I have previously stated, I had but one object in dealing with the drying stage, namely, that of showing the difference between "thorough drying" and "partial drying." Not that the equivalent of fuel in this item correctly represents the actual amount of fuel used in practice, though it does represent the amount of work done. The calculations are made per lb. of material remaining at the several points; the percentages at the begining, therefore, do not effect the results at the conclusion. Thus the 4 lbs. of water of combination, shown at the calcining stage (though 4 per cent. of the original quantity), would appear, in an analysis, as 6·35 per cent., which is about an average. Silicious clays being, perhaps, only a third, whilst aluminous clays are, probably, double that, I have, therefore, aimed throughout at an ordinary range of things, though I am fully aware that there are many cases beyond the extremes I have shown in either direction.

Before considering the different modes of firing and comparing gaseous fuel with solid, I will just notice the question of speed, so far as any difference is shown between short draughts or ordinary kilns, and long draughts or continuous kilns. The time occupied in what is called the steaming period, which really includes the calcining period, varies considerably in different clays, from the amount of combined water, ranging as it does from an almost imperceptible quantity up to, say, 14 per cent.; nor is this the only item influencing the speed. I do not, however, wish to do more here than recognise that there is a great difference. There is also a difference in the speed of absorption of heat during

the burning process. Now these differences may have a considerable effect upon the treatment, when comparing the two systems. For argument sake, supposing the calcining heat of a certain clay penetrated at the rate of 10 ft. per day, and its burning heat at 20 ft., it is evident that the average rate of kilning would progress at the speed of 15 ft. per day; but in a continuous kiln, since all the stages are going on at the same time, the speed must necessarily be that of the slowest item, unless special arrangements be made to correct this evident disadvantage of the continuous system in the treatment of such clays. In the case supposed above, without any such special arrangement, the speed would only be 10 ft. per day in a continuous kiln, but if the steaming and calcining stages are assisted by extra fires some little distance ahead of the burning fires, this loss of speed can be made up.

So far it has been assumed that the fuel used is coal, and the mode of burning it (in the common kilns at any rate) an ordinary fire. It will be well, now, to compare the differences between burning with solid coal and with gas. The actual thermal power of solid carbon burning to carbonic acid is 12,906 thermal units per lb.; which may be taken for my present purpose as representing coal. The gas we use for such purposes is practically carbonic oxide, which has a thermal power in burning to carbonic acid of 10,411 thermal units per lb. of carbon. To begin with, then, we notice that the value of fuel in the form of gas is about 20 per cent. less than that in the form of coal, as is well-known, though fuel in this form has compensating advantages, such as is shown in Dr. Siemens' regenerative furnaces, where the means by which this loss is made, is the means by which we gain a greater advantage, the balance being left in favour of gas. And many gas kilns have been patented by Dr. Siemens and others, worked upon this regenerative principle, and modifications of it; but none of them have met with the success hoped for, and why? Firstly, we have the disadvantage of 20 per cent. in the fuel, as I have already shown; and this 20 per cent. of difference is supposing that the gas is perfectly made, which rarely is the case in practice, for air leaks in, or gas leaks out; either way it is a loss; and then a portion of the carbon deposits in the flues in the form of soot, and costs money to remove. The more important deposit, however, and costing still more to remove, is that of the hydro-carbons, namely, tar and pitch. As a matter of fact, an average sample of coal, burning to carbonic acid, yields 10,376 units from its carbon, and 2,630 units from its hydrogen, making in all 13,006 units. Now, a very large portion of this hydrogen is lost in the flues of a gas arrangement, and, with it, the portion of carbon with which it combines, so that, altogether, the imperfections are great, requiring the advantages of the gaseous state to be very great to compensate and make it worth while to incur the expense of forming gas-producers, dampers, flues, valves, and ground, all being items against the use of gaseous fuel. But, can any of these disadvantages be surmounted? I thought so a few years ago, and took out a patent thereon, one form of which is represented in the figures on p. 243, and which I will now describe following the same course of development it took in my mind at the time; and which sprung from the question—Why not put the gas-producers within the kiln? If this can be done, the first thing we save is the difference in the thermal value of the fuel; for then we have the heat generated in the making of the gas, amounting to 2,495 thermal units, added to that of 10,411 thermal units from the gas, making 12,706 thermal units, the full value of solid carbon burning to carbonic acid direct. If this can be, we further save the precipitation of solid carbon in the form of soot, as well as the hydro-carbons, or tar and pitch. We further save all possible risk of loss by leakage and imperfect firing. We save the cost of the greater part of the gas-producers, flues, and valves; and, lastly, we save all possible risk of explosion, for the gas being at a high temperature ignites the instant it meets with air, rendering explosion impossible.

Having come to the conclusion that such a state of things was possible, I looked about me for an example. But nowhere could I find one answering all the requirements indicated. And it was after this fruitless search, that I took out the patent represented by the drawing before you. It is, what I should call, a sectional perspective, and shows nearly every part on the one sheet. The chambers in which the goods are placed are indicated by the letter A. The gas producers by the letter G, the flue leading to the chimney by the letter L, and the wickets by the letter W. In making this arrangement, I have kept the following points in sight. Firstly, that the form of the chambers should be no departure from those in general use, and proved to be of good shape and proportion; secondly, that the heat should rise from a similar position within those chambers; and thirdly, that the draught should take the same course through the goods. All risk as to change of form is thus done away with, so that if we can save the fuel, and produce the same heat, we cannot spoil the goods, nor burn them to an inferior quality. The *modus operandi* is this: the goods having been placed in several chambers, and the wickets made up, fires are kindled in the gas-producers, and the process of steaming, calcining, and burning carried on in much the same way as usual. Rather open fires being worked at first, with plenty of air, gradually making it hotter, and limiting the air as the successive stages are completed. At the beginning of the burning stage, however, the fires are made deep and close, working them like a gas-producer instead of an open fire, and filling them up until the fuel touches, and perhaps rises slightly above the sill of the air port shown at the back of the producer in the division wall. By this means, the amount of air can be regulated by the fuel; for if the air port be partly closed, and there is a good draught on the kiln, it is evident we can force more or less air through the body of the fire, as we please, and maintain a perfect control. Here, then, we have got our gas-producer, working exactly as any other gas-producer, and have a decided advantage in cheapness and simplicity. It has no dampers, coal chargers, fire-bars, or any ironwork whatever, further than a small lid at the top, through which the coal is dropped directly upon the fires. All the required conditions are complied with, and we get the full thermal value of the coal.



SECTIONAL PERSPECTIVE OF GUTHRIE'S PATENT GAS KILN.

The firing is thus carried on till the chamber is nearly finished. Meanwhile, as you will see by the arrows, the draught has been leaving this chamber at the floor level and going through the next. This waste heat from the first chamber is being utilised in preparing the second for the firing process, and warming the gas-producers; and when the heat in the second set of gas-producers has arrived at a good redness, the firing at the second chamber is begun, and shortly afterwards the firing of the first is stopped. But what takes place in the firing of the second, and all subsequent chambers, is very different to that of the first. In the first, the goods were cold to start with, but in the second and subsequent chambers, there is a red heat, into which we put the coal, consequently it at once ignites, and makes good gas; the steaming process is already completed, and hard firing can at once be gone on with; and again, the producers being already at a red heat, some of the gas is made without the admixture of air, as in a retort; and, lastly, what air the producer uses is at a red heat, and does its full additional amount of work. Likewise, the air going through the air port, to consume the gas, is at a red heat, so that the heat of combustion in the second and subsequent sets of producers is added to the heat coming from the chambers just completed, resulting in a most intense heat, and a most perfect combustion. When in full work, the number of chambers connected in one system of draught is about seven or nine, according to size and kind of goods. There may be four chambers behind the fires, cooling, and passing their waste heat on to the other four in front of the fires, thus keeping up a continuous system.

But how about speed, and the assistant fires I talked of as necessary for certain clays? They are provided for by introducing an arrangement similar to an ordinary Newcastle kiln. Small firing holes are formed at S, in the wicket, and at the other side of the wicket as well, if necessary; so that we can make sure no time is lost for want of the steaming being done as fast as the firing can be made to approach it. There is another use in these doors, and that is, that should a chamber be ready for finishing off, before its next-door neighbour is ready to be connected, the perfection of the corner, that might be otherwise lightly burnt, is secured by lighting the fire at S, and should a single chamber only be required to be burnt, it can be treated in exactly the same way. The kiln can thus be made to work either continuously or not at pleasure. One chamber can be made high to suit a certain class of goods, and the next low to suit another; one chamber can also be worked much hotter than the next, or *vice versa*, as may be required.

But now let me turn to the fine quality of goods, such as terra cotta, fine tiles, and pottery. It is important to have a clean intense heat for this class of goods, with as little dust as possible. Well, it seems to me, we have the clean intense heat without a doubt, and, as to the dust, it stands to reason, that if we burn but a third of the fuel, as is the case, we have but a third of the dust, even supposing all else to be the same; but, in addition to this, there is only half the fire surface, from which draft ascends to carry that dust, therefore, only about one sixth the amount of that in an ordinary kiln.

Roughly, I have said that about one-third of the fuel is used in good continuous kilns, as compared with the ordinary type, and I have shown this to be quite true, both by calculation and experience, so far as heavy goods go, but where the lighter and superior class of goods are burnt, such as I have just indicated, the case may be very different. In the former case the goods are packed into the chambers without protection, but in the case I now propose to consider they are protected by being placed in seggars, and the weight of these seggars being very often in excess of the goods within them, very materially alters the expenditure of fuel upon the goods turned out. In non-continuous kilns the whole of the heat at the finish, and about as much again, as I have shown in the last stages of the table, is lost, the whole being equal to about two-thirds of the total amount of fuel expended. In the case of the finer goods, where seggars are used, the loss is greater in exact proportion to the additional weight of seggars. If, in the first case, the waste heat was equal to 6 cwt., and, in the second case, supposing the weight of the seggars to equal that of the goods, the waste would be equal to 12 cwt. It therefore becomes a more serious item than we, at first, might expect. But as this is only an assertion, I will explain how I arrive at this conclusion. We have seen that the largest item of thermal expenditure irrecoverable is that necessary to drive out the water in the goods, and is in exact proportion to the amount of water present. The remaining irrecoverable portion is that lost by conduction and radiation, which is in proportion to the surface exposed, and the total heat attained. It is not necessary here to notice that portion constantly going up the chimney, and required as the mechanical power for maintaining the draught, for that has been allowed for in the effective value put upon the fuel, and does not effect the question. In our present case then, how much water have we to drive out? Supposing the proportion in the goods to be the same as before, and the weight of the seggars to equal that of the goods, the proportion of water to that of the charge in the kiln, goods and seggars included, must be only half. So, referring to the table again, we may take away half of all these items referring to water, everything else remaining the same. The result is, that the total spent in extracting the water in the former case is just over 2 cwt., therefore, in the present case, it is only 1 cwt. 3½ tons of our materials, charged in the present case, then, requires, if they are of the milder class, 1 cwt. less than the former case, making, with a non-continuous kiln, 7 cwt. 2 qrs. 11·2 lbs. Now, in a continuous kiln, the same amount of heat can be utilised as before. 5 cwt. 2 qrs. 21·3 lbs. taken from our present total, leaves 1 cwt. 3 qrs. 17·9 lbs. In the former case the proportional advantage of the continuous system over the non-continuous, in point of fuel, was as nearly as possible 66 per cent. In the present case it is just 75 per cent. This proportion will vary with the kind of goods burnt, the heavier goods showing a less per-centage, and the lighter goods a greater. It must be acknowledged though, that the quantity of fuel consumed in the manufacture of fine goods is not a point of so much consequence as with the heavier and commoner kinds, and that, in certain cases, it may not always

be possible to make use of the waste heat. Nevertheless, it is possible in all works, except those of the smallest dimensions, to utilise the waste heat of the greater number of burnings. Therefore, it will be a very great advantage to be able to work on either system, as the work in hand may require. And even in small works, with any prospect of increasing, it will be of great advantage to be able to construct a kiln capable of indefinite extention, as well as of being worked continuously or non-continuously, as occasion may demand.

To do full justice to an investigation of this character, would require much longer time than can be accorded one sitting. I have kept as nearly as possible, in my supposed illustrative cases, to facts, and to the practice of works I have had immediate connection with. The diagrams and tables, while showing the facts of one or two cases, are not of universal application in the results obtained; but they are of universal application in the mode of getting at those results. The thermal analysis might be pushed much further, and in practice I should certainly do so; but for the purpose of this evening, it was not expedient, lest I had taken up the whole of the evening in following figures, which, however instructive, would not be very entertaining. With more time, I might have taken into account the effect certain impurities, known as fluxes, had upon the kilning process and the colour of the goods; also the process of glazing. But any one of these points would require more than an evening to itself. Another subject, also of vast importance, would require time, namely, that of discolouration. But in reference to this, I will only quote the words of my friend, Mr. Percy J. Winser, analytical chemist of Manchester:—

"With a careful analysis of a clay, I see no reason we should not be able to predict the results of manufacture, both as to colour, use, and quantity of fuel necessary to burn it."

The following communication has also been received from Mr. Winser:—

Marsden-chambers, Marsden-street,
Manchester, February 11th, 1880.

My Dear Mr. Guthrie,—At your request, I have made a careful examination of the "grey" or "white-end" bricks, which you were good enough to procure for me, with the view of ascertaining the nature and cause of a deposit or stain on their surface, and I now have pleasure in sending you the following results of my investigation:—

The bricks are ordinary red ones, the inside being of a darker and more purple tinge than the parts nearer the surface, the colour of which is more of an orange-red.

The stain in question is a greyish or yellowish-white film, of varying thickness, which adheres strongly to the more porous brick, and appears to harden with exposure to the atmosphere, being more easily detached from fresh-burnt bricks than from those which have been out of the kiln for some time. In nearly every case examined, the part immediately below the film was found to be thickly dotted with white specks, which become less numerous as they recede from the surface. The deposit only occurs on those faces of the bricks which are exposed to the direct action of the hot fire-gases; bricks in the cooler parts of the kiln, or which are protected from the hot draught by others placed close to them, being quite free from stain. The following analysis will show the difference in the composition of the bricks and the stain, the "orange-red brick" being taken as free as possible from the white specks mentioned above, and the "stain," having as little of the red brick with it as its extreme thinness would allow. For the sake of comparison, I have added an analysis of the clay from which the bricks are made.

Per-centage Composition of the Materials, dried at 212° Fahr.

	Brick Clay.	Brick.		"Stain."
		From middle, Purple-red.	Outer portion, Orange-red.	
Silica	62·03	65·25	65·61	54·00
Alumina	17·60	17·80	18·07	15·02
Peroxide of iron	6·72	6·47	6·24	5·69
Lime	1·46	3·22	3·30	13·90
Magnesia	2·16	3·81	3·81	3·08
Loss on ignition (chiefly combined water)	6·02	.....	.....	not determined.

Showing that the chief difference between the stain and the brick is in the proportion of lime, the stain containing about four times the quantity present in the brick itself. The lime in the clay exists partly as carbonate, partly as sulphate. The water solution of some parts of the stain was strongly alkaline to test-paper, the lime being present as hydrate; whilst in other cases it had absorbed carbonic acid from the air, and so lost its causticity. Unfortunately, I could not separate sufficient of the stain to make any determinations of the relative proportions of lime existing in the different combinations.

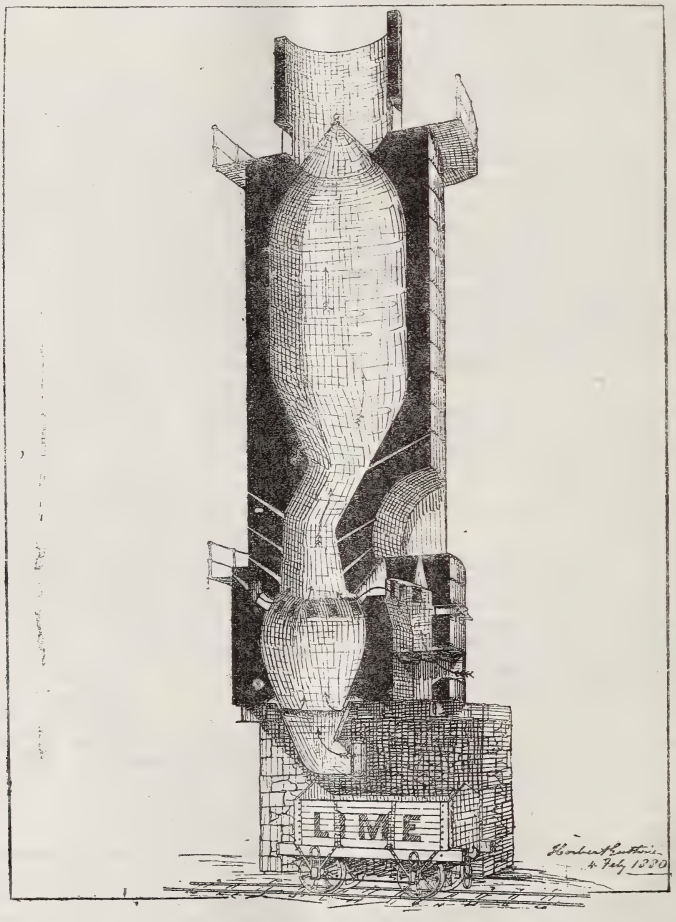
The stain would, therefore, appear to be a sort of cement or mortar, the lime of which is probably brought to the surface of a brick exposed by the water driven off during the burning; the quantity evaporated from the free surface of a brick exposed to the direct action of the hot gases being, of course, very much greater than that from those faces which are colder and more closed in, thus explaining why the deposit is only produced in the situations named. And the large proportion of lime found in the stain would also explain the practice you mentioned to me some time ago, viz., that when "white-ends" are specially required, some makers add to the clay a small proportion of the "soda-waste" from alkali works, this "waste" being chiefly a mixture of compounds of lime.—I remain, dear Sir, yours faithfully.

Percy J. Winser, F.C.S., &c.

Lime-kilns.

And now, if not trespassing upon you, I should like briefly to draw your attention to the burning of lime. The same course may be taken in calculating the thermal expenditure in the calcining of lime as in the burning of clay, the only great difference being in the substituting of carbonic acid for water. In both cases the irrecoverable heat is carried away in a latent state, though in greatly different proportions to the weights of the materials. We cannot, however, treat the carbonic acid as we did the water, for, unfortunately, the latent heat of carbonic acid gas in limestone has not been determined. There is a very short cut, though, to an approximation of the probable minimum expenditure. We can get at the amount of heat in the charge at the moment calcination is completed, so that, providing all other precautions are taken to prevent waste, as in our previous case

of clay burning, that is the amount available for utilisation. We must, however, take into account any differences there may be in the specific heats, and make the proper allowances. The specific heat of limestone is within 17½ per cent. of the specific heat of clay. If we add 17½ per cent., then, to those items in our table, we shall get what we want. The table shows that the equivalent in fuel of the available heat is 5 cwt. 10 lbs. for 3½ tons of clay, which equals 1 cwt. 1 qr. 23 lbs. per ton; 17½ per cent. on to this is 1 cwt. 2 qr. 24 lbs. But this is something like putting the cart before the horse, for we have not stated from what this has to be deducted. We know for a fact that we can produce 1 ton of lime in the old style of kiln with a third of a ton of coal, or a shade over, say, 6¾ cwt. We know for a fact that, on the continuous system, 1 ton of lime can be produced with 5 cwt. of coal. If my inference is right, then the difference between these two qualities should be the same as that I previously made out, and if you will notice, there is only a discrepancy of 4 lbs. Coming so near as this upon two very different classes of goods is very strong evidence that the trains of reasoning and calculation are correct, and this was one of my reasons for bringing it before you. I have not lost sight of the fact that an ordinary lime-kiln does not work exactly in the same way as an ordinary clay-kiln. A common lime-kiln is a continuous kiln after all, and makes use of the greater part of its waste heat; but it wastes a very large portion of its fuel in doing this, by converting it into gas before it can be used, so that on the whole it just about loses in the one what it gains in the other, and our figures may stand good.



Lime Kiln.

The diagram of a lime-kiln before you represents one at Arnside, near Carnforth, that I built for Mr. Crosland, and is an outgrowth of the same thoughts as those upon which the other kiln was built. It approximates very nearly to a patent of Dr. Siemens, and might be fairly termed a Siemens Crosland, or even a Siemens Guthrie's Crosland. So far as the feeding is concerned, it is the same as the old-fashioned kilns. The stone is pitched in at the top and raked out at the bottom. But there is this grand difference—no fuel is put in along with the stone, the firing being done in a similar way to that of the first chamber of the clay-kiln, with one slight difference, namely, we manage to

get hot air for burning the gas, though we do not for making the gas. This is not a disadvantage in this case, for we have not the reserve of heat in lime burning as we had with clay goods. The air can pick up the whole of this; therefore, there is no object in turning it into the gas-producers. In the case of clay goods, the heat available for utilisation was two-thirds of the whole; but with lime, owing to the vast amount of heat taken away latent in the carbonic acid gas, it is only one quarter of the whole. Here, then, while we retain all the advantages of the old rough-and-ready way of tipping the stone in at the top, we obtain, also, all the advantages of the best continuous system. There is another peculiarity worth noticing. There is a sloping part of the shaft just above the hottest part of the kiln. The object of this is threefold: firstly, the heat and draught is not so likely to keep to one channel, but has a tendency to cross the stream of descending stone; secondly, the stone has a tendency to roll over and change place in the opposite direction to the heat; and, thirdly, the slope carries a great part of the weight of the stone above it, which, with limes and cements that have a tendency to clinker, is a great advantage. With such materials, I should form the hottest part of the kiln with a slight taper, so that there would be a constant tendency to relieve the material of pressure so long as there was any fear of clinkering. So far as fuel is concerned, I do not suppose this kiln will be much more economical than any other good continuous kiln. It will gain a little, however, upon such a kiln as the Hoffmann, where the fuel is put along with the lime, and a small extra loss incurred by the mixture of ashes. In the kiln before you, not a particle of ashes gets along with the lime, the whole coming out pure, and requires no more sorting than perhaps the picking out of a stone occasionally. Small or large, it is good clean lime, and can be sold as such. The gain altogether of such a kiln over a horizontal, for the same purpose, is very great, for the labour in setting the stone and taking it out again in the horizontal system is considerable, while, with the vertical system, both the tipping in and the raking out is a mere trifle.

And now, hoping I have not altogether wasted your time or exhausted your patience, I must bring my paper to a close.

DISCUSSION.

Mr. Guthrie explained, on the diagrams he had prepared, the mode he had adopted of calculating the amount of heat passing up the chimney of his kiln upon the basis of the amount given off in ordinary non-continuous kilns.

The Chairman said the gentlemen present would agree that anyone who should discover an improved and more economical method of making bricks and tiles, and for the construction of better furnaces and kilns for burning pottery, was really deserving of national thanks. He did not think there was any subject of greater interest than that of how best and most effectually and economically to burn pottery. Attention had been very much directed of late years to the subject, and the suggestions now thrown out in the interesting paper just read were certainly very valuable. If the man who made two blades of grass to grow where but one had grown before was, as had been often said, a public benefactor, surely general thanks were due to Mr. Guthrie, who appeared to have discovered a method of making one ton of coal do the work in that direction which had hitherto required two. There could be no question that in such a system there must be great advantage; but there was still the practical difficulty that unfortunately manufacturers could not get continuous orders for the same class of goods, or indeed continuous orders at all, so that it would be very difficult to keep a manufactory supplied with the regularity which any scientific system, such as Mr. Guthrie's, appeared to require. He thought that of all the beautiful systems at present in operation, Hoffmann's plan seemed to be the most perfect. He had one of Hoffmann's kilns at work in Lancashire, and he could state that the work it did was most cleanly, and that the quantity of fuel burnt in it was very small. As a proof that the whole of the heat was abstracted in the kiln, he found that the chimney itself was simply warmed, just enough to create a draft. In short, he considered Hoffmann's a very perfect system, and efforts had been made to apply it to the burning of pottery. He might say that this system of burning pottery was not altogether new to him, for he had made experiments with it in Lancashire, in 1869, and had succeeded in burning pottery very satisfactorily by it, but he had found there were expenses and disadvantages which induced him to abandon it for the time, although he would not by any means say that it was a system which was not likely to be carried to success in the future. It was undoubtedly a cleanly process, and in many respects a very beautiful one. Mr. Guthrie's speciality, as he understood, was in the management of the kiln or gas-producer itself, and it was impossible to say without seeing detailed diagrams, and going fully into the matter, how far Mr. Guthrie had been able to effect his object with any permanent success; but if he had really been successful in doing so without any accompanying disadvantages, he would, no doubt, be entitled to the greatest thanks for his labours. As no one present seemed disposed to carry on the discussion, he would not detain the meeting with further remarks, but would simply add that he felt they were all greatly indebted to Mr. Guthrie for his very able paper on a most interesting subject, and they would, probably, even better appreciate the paper when they had the opportunity of reading it in the *Journal*, and could see how evidently it was the result of long and hard work. Pottery manufacture was a most seductive art, and one in which there had been, and would continue to be, continuous improvement, for people who knew anything at all about it, would acknowledge that they knew a great deal more about it when they had had ten years' experience in it than when they had had but one, and far less even after a ten years' knowledge of it than when they had had a twenty years' experience. He had only, in conclusion, to invite a vote of thanks to Mr. Guthrie for his able and interesting paper.

The vote was carried unanimously, and the meeting terminated.

FOREIGN AND COLONIAL SECTION.

Tuesday, February 17th, 1880; Dr. B. W. Richardson, F.R.S., Member of the Council, in the chair.

Mr. Mitchinson said he had not had much opportunity of studying the English language until lately, and was not a physician; but the opinions stated in the paper about to be read were the result of personal observation in various parts of the world. He had visited Moscow, St. Petersburg, and the University of Leipzig, and, since then, had travelled in nearly all parts of Africa, going down the

West Coast, with visits to the interior, up most of the rivers, reaching Cape Town, and going thence to Delagoa Bay, and so to the East Coast. He wished it to be understood that his friend, Mr. Guest, had assisted him in preparing the paper, and, for the reason he had given, Dr. Mann would be kind enough to read it.

The paper read was—

THE PRINCIPAL CAUSES OF DISEASE IN TROPICAL COUNTRIES.

By Alexander William Mitchinson.

The greatest impediment in the way of the development of some of the most favoured portions of the earth is the unwillingness to settle permanently within the tropics that characterises certain nations, otherwise remarkable for their colonising energy. This disinclination to colonise tropical countries doubtless arises from mistrust of what is called the climate. It is on all hands allowed that climate exercises a great influence on health and disease, and it is usual to speak of a climate as if it were an element, like the wind or the rain, and to attribute to it either virtues or evil properties, according to our conception of its character. But what is climate? What constitutes a bad, and what a good climate? Is a climate to be called bad in which a black man can happily and contentedly live the full term of his life, because in it the white man can only count upon a diminished term of existence? Is our temperate climate to be stigmatised as bad because it rapidly kills off natives of the tropics who do not adopt a different manner of clothing and feeding themselves here from that which has kept them in contented health at home? If a native of tropical Africa, residing in Europe, were to limit his food in quantity, nature, and quality to that which is sufficient to maintain life in his own climate, his bodily and mental condition would rapidly deteriorate, and he might, with equal reason, allege that he was being poisoned by the climate of Europe. If the views put forward in this paper are held to be true, it will be admitted that health in the tropics, as everywhere else, is much more dependent upon diet and habit of body and mind—and, in towns and villages, upon good sanitary regulations—than upon what is known as the "medical climate" of a given place, or upon the barometrical, thermometrical, and hygrometrical variations peculiar to a given district. It will be admitted, in short, that acclimatisation is more of an educational than a physical process, and that when a European has learnt correctly to apply the principles of hygiene, he may live his life in the tropics with equal or greater certainty than in temperate climates. It may be said, indeed, that though there are good and bad situations, swamps, and malarious localities, there is, in the common sense of the term, no such thing as a bad climate. All climates are good for man to live in if he applies intelligently the principles of sanitary science to the regulation of his life. But the same cannot be said of all localities. There are towns in Africa which, like Bathurst, on the Gambia River, Delagoa Bay, in South Africa, and a large number of others, are pitched on sites the worst possible, sites that could hardly have been deliberately selected on any intelligible principle, but must have been pitched upon almost haphazard by the earliest European settlers. Many of these sites are scarcely raised above the level of the sea, and some are even, in part, below it; so that drainage is practically impossible, filth cannot be removed, and, in short, all the worst sanitary conditions of the worst periods of the most neglected spots of Europe are intensified and aggravated in the badly-situated towns of Africa. How, then, can the death-rate be otherwise than high? That man can exist at all under such horrible infractions of every sanitary law is itself a proof that the general climate is excellent and favourable to health. It is just as absurd to charge on "the climate" the high mortality of a pestilential African town site, as it would have been to call the climate of London bad when the Fleet Ditch was an open sewer.

Climate, if it is capable of definition as a distinct conception, may be said to be the sum of the meteorological influences that affect a given region of the earth, including in the term meteorological influences, not only the influence of elevation and of latitude, but that of the internal heat of the globe, the geological structure of the earth's crust, the topographical condition of its surface, the quantity and quality of water, the currents of water and of the air, and the distribution of vegetable and animal life, including human population. Except in so far as it may affect a region generally, it is illogical to speak of the climate of swamps and malarious places, just as it would be absurd to say that the atmosphere of Barking Reach, at ebb tide in summer, represented the climate of Kent. The conditions in both cases are quite exceptional, and the risks are exceptional also. The distinction is important, because it constantly happens that whole regions are condemned as having a bad climate, simply because careless settlers have built upon a malarious swamp, and equally careless traders have followed upon their foundations, when a little search would have enabled both to find, and generally within a short distance, a much more eligible situation.

There are within the topics but few variations of temperature, the greatest range of variation being in the parts most distant from the equator. The thermometer generally rises higher on the plains than in the mountains, but this will be influenced to some extent by geographical position or geological formation. The variations are greater in summer than in winter, and, as we might expect, the range of variation is less on the coast than in the inland districts.

The study of the meteoric causes of disease has engaged, and is still engaging, the attention of many scientific men, and careful meteorological observations are very properly recorded by travellers in tropical climates; but those who have attempted to apply the data of meteorological science to the healing art have, as yet, had but a small modicum of success. Without denying the importance of the study of that science, or questioning the value of many of its facts, it is open to great doubt whether a too great reliance on meteorology by a physician does not frequently blind him to the real causes of disease and lead him far astray in his efforts to prescribe remedies. I have no hesitation in affirming that, if we could establish a system of registration in these tropical climates, which would furnish us with reliable statistics as to the variations of the death-rate from month to month, and from season

to season, we should make a greater advance towards a knowledge of the true causes of disease in the course of a decade than by meteorological studies alone during a century. The contradictory directions given by different medical men to persons proposing to visit the tropics, and the want of intelligence which such persons often show in their interpretation of these directions, afford the strongest proofs both of our ignorance of the true causes of tropical mortality, and of the great importance of our not remaining longer in that ignorance. Many physicians recommend a generous diet, intended to fortify the constitution of travellers bound for a tropical country; and this advice, though good in principle, being wrongly interpreted, encourages inordinate feeding on board the steamer which takes the traveller out. This first error is a serious one, and often leads to the worst consequences at the outset. Some doctors, again, will recommend you never to start on a journey without eating. Too much food is taken, and the stomach having a greater task to perform than it is capable of, a breakdown ensues. Others advise an adherence to regular meals at fixed hours, and, under this system, the human organism is converted into a machine, depending for its efficiency upon strict regularity; but the conditions of out-door life, in the circumstances of most of us, are necessarily varying and irregular, and the mechanically fed body, like the machine it has come to resemble, is, therefore, constantly getting out of order.

Most of the diseases, attributed in a vague manner to climate, in the erroneous popular use of the term, are, in fact, caused by wrong dietary usages. Every country and climate has its own appropriate dietary laws—unwritten laws, for the most part—but rules appropriate to Europe may be quite inapplicable in Africa. Forgetful of this, Europeans in the tropics, instead of reducing the quantity and varying the nature of their food on intelligent principles, too often insist on taking, in the same or even increased quantity, the rich foods, wines, spirits, and condiments they have been accustomed to in Europe. The stomach, with power diminished by climatic conditions and the burden of a task which it is unable to perform cast upon it, fails to digest all it has been forced to receive, and evinces its distress by causing the usual symptoms of such tropical disorders as are commonly charged against the climate. The circulation of the blood becomes abnormally quick or slow, and the subject either becomes restless and irritable or listless and sleepy, with an overpowering sense of fatigue and desire for rest. The heat of the climate is supposed to cause this abnormal state of the nervous system; but, in reality, dry heat aids the process of digestion, and, other things being equal, if heat were absent, the worst symptoms of an overloaded stomach would be more quickly developed. A high temperature tends to increase the circulation by drawing the blood to the surface; and so to mitigate the symptoms of disease through diminishing the power of the heart's action; and also modifies the respiration, by lessening the quantity of oxygen in the atmosphere. The evil moral effects of overfeeding are strongly accentuated in tropical climates. The mind and the memory, as well as the animal passions, are more powerfully affected by the adoption of a too rich or a too poor diet, and the physiognomy registers, in a remarkably faithful manner, the nature of the disorganisation taking place in the nervous system in consequence of a departure from the dietary law proper to the region.

One of the most remarkable effects of a long residence in the tropics is loss of memory and of mental capacity. This derangement is due, in a measure, to tropical heat, but not to the extent commonly believed. Too much solitude, insufficient variety of incident, and, above all, want of mental exercise, are in a far greater degree responsible for the disease than the enervating effect of climatic heat. Even in Europe, with all the incentives to mental activity that surround us, we often find persons more ignorant at an advanced period of life than during their school days; but, with the distraction and currents of thought caused by contact with more active neighbours, it is impossible for the most sluggish mind in Europe, except in very isolated places, to fall into that dreamy, passive state to which the monotony of life in Africa so easily disposes. Europeans in Africa do little else than eat and drink, rest and sleep. They seek for nothing to occupy the mind, and they will often sit for hours gazing at vacancy, with their thoughts swimming in clouds or jumping from one subject to another, undirected and unrestrained, until, from want of judicious exercise, the mind gradually sinks and perishes, and the man becomes either a hopeless imbecile or a violent madman.

Solitude, and the monotony of tropical life, in the case of the white man, have a strong tendency to produce nervous prostration and debility. When a man has allowed himself to lapse into this state of mental apathy, he is far more liable to an attack of fever than one who preserves his mind in a state of healthy vigour, by forcing it, if need be, to think, reflect, compare, and remember. The connection between mental and physical weakness is strongly marked in the tropics. Imaginary sicknesses developing into real ones is a common phenomenon in all climates; but, in tropical Africa, I am of opinion that no less than 75 per cent. of the prevailing disease is of that character which, without the application of medicinal remedies, may be cast off, simply by the exercise of a strong will, and of intellectual and moral power. But the power of the brain is supposed to be weakened by climatic heat, and, no doubt, long-continued mental effort in the tropics is, in a peculiar degree, exhausting. The exhaustion is not the result, however, of any direct action of heat on the brain, for the intellect is as vigorous, clear, and enduring in a hot as in a temperate climate. Headaches, which are so common in Africa, and the tired feeling in the brain which there more readily follows mental exertion than in Europe, are the results of the direct action of heat, not on the brain, but on the blood, which, if not maintained in a normal state by judicious diet and bodily exercise, reacts on the brain to produce the feeling of fatigue. The power of the brain would, in any climate, be prejudicially affected by overcharging the stomach. The action of climatic heat on the blood requires to be counteracted by reducing the quantity and quality of food; but, under the impression that the exhaustion of the climate must

be met by more and richer food, Europeans often increase the quantity, and eat, in fact, nearly twice as much as nature requires. The ham, cheese, nuts, fruits, cucumbers, condiments, and even narcotics, they have been accustomed to in Europe, must all be swallowed in due course, and the distresses of the stomach and brain which necessarily follow are set down to the climate. If Europeans would live more consistently with nature, disease and mortality would greatly diminish, and the brain would be as capable of continued exertion in the tropics as anywhere else. The deficiency of brain power which is supposed to mark the African race may be thought by some to be a proof of the direct influence of heat on the brain. If the advantages of training and culture possessed by Europeans are taken into consideration, the superiority of the settlers over the natives in brain power is not so strongly marked as to lead those who have studied the higher races of Africa most closely to admit that inherent superiority in quantity and quality of brain which the white man commonly assumes to have. It will, I think, be found that, if the same amount of exercise be given to the reasoning faculties in the tropics as we give to them in Europe, the state of forgetfulness will not be reached, and the mind will retain its vigour unimpaired. But the usual incentive governing the white inhabitant of the tropics is the amassing of money. He may be said to be a man of one idea—I will not run the risk of causing offence by the use of a stronger term—and the man of one idea must necessarily allow most of the faculties of his mind to rust. His mind becomes weak from want of exercise, and he falls an easy victim to the tropical disease "loss of memory."

Nothing more powerfully contributes to shorten the white man's days than the habit of drinking strong spirits. The use of the alcohol of the apothecary is beneficial when a cold may have been caught, but the stomach should never become accustomed to it, for the habitual use of it deprives the blood of oxygen and causes it to give out an excessive amount of oxy-hydrogen gas. A very large proportion of the Africanders of the tropics, as the white settlers are sometimes called, will indulge in brandy on an empty stomach; before midday, perhaps, an emptied spirit bottle is sent flying into the street; and, in the afternoon, abundant evidence is everywhere forthcoming of the indulgence of the morning. The temperature of the blood rises dangerously near the fatal 102°, and, in their alcoholic excitement, such men will often over-exert themselves, producing excessive perspiration, followed by great thirst, and a further dangerous consumption of liquids. Oblivious of the danger, and heedless of the warnings of natives, and of wiser and older residents, they will frequently walk or repose in malarious places just when their heated, perspiring condition is most prone to the attack of miasma, and, if any harm then comes of it, the horrid "African climate" is held responsible. I would unhesitatingly refuse to a patient the mixture of water with brandy or with wine—a mixture erroneously, but almost universally, supposed to be beneficial in Africa. Some medical men, even, recommend the use of spirits to stimulate a failing appetite—a most unfortunate recommendation. If a man is not hungry when his meal-time arrives, it is far better that he should simply walk away from the table and wait till his appetite returns of its own accord. The absence of appetite will generally be merely an indication that his stomach is not yet ready to undertake a fresh task, and he should place it under no compulsion except such as can be naturally produced under the stimulant of bodily exercise.

White men in Africa are, as a rule, afraid to expose themselves to the changes of a tropical temperature, and this timidity is only too much encouraged by the advice usually given by medical men. By judicious exercise at different periods of the day and year, the body becomes accustomed to the changes that take place suddenly in the open air, and the exterior nerves so comport themselves as to prevent the internal organism from feeling the change too suddenly. The active duties of life make it imperative to encounter these atmospheric changes to a greater or less extent, and the body that is prepared for them is, therefore, in far less danger than the too-sensitive organisms of those who take too much care of themselves. The rapid swelling of the *papillæ* and the strong local *hyperæmia* experienced by sensitive persons on entering a hot climate, or on changing from a hot to a cold climate, may be set down to this cause, and the quick drying, cracking, and yellowing of the skin experienced by such persons are others of its results. The slightest exertion produces profuse perspiration, the respiration is diminished, and, through the undue activity of the sudorific glands, the kidneys are loaded with solid matter and the elementary organs are called upon to do more work, while the destruction of the tissues is stimulated and the work of the formative organs is retarded. On the other hand, when the nerves have been hardened by judicious exposure to the vicissitudes of the climate, they act admirably as regulators of the evaporation, prevent exhaustion after slight effort, while promoting a healthy degree of perspiration and maintaining a just balance among the various functions which the different organs of a healthy body are at every moment performing. "Be temperate in all things" applies to this, however, as well as to eating and drinking. Excess is always hurtful. Certain precautions must also be observed, but these will be considered further on among the remedial measures to be adopted in the tropics.

Of the peculiar diseases of tropical climates much cannot be said here, but it may be remarked that by far the largest part of the mortality in connection with them (excluding cases of malarial fever) results from the diseases which flourish everywhere, except in that ideal city of "Hygeia" which one of our most famous sanitary reformers has so happily imagined.

In the face of the ignorance of sanitary science which we find in European communities, it is, perhaps, not surprising to find that science entirely unknown in Africa. I was somewhat startled, however, to find that such an official as a sanitary inspector had scarcely been heard of, although there can be no place in all the world where the functions of such an officer could with greater benefit be performed than in the West Coast towns of Africa. The most appalling indifference to the presence of festering sewage in the midst of a town popula-

tion pervades the inhabitants. Thousands of gallons of putrefying animal and vegetable refuse, in uncovered, or barely covered, holes in the ground, form cesspools close to the dwellings; and as they have many of them not been emptied for years and years, the nauseating mixture of urates and phosphates with free ammonia, sulphuretted hydrogen, and other gases that ensues is intolerable. The air, through the neglect and lazy indifference of the population, is loaded with horrors; and, when these people die of the poison they have themselves created, they say it is the climate that has killed them.

A sanitary inspector would make a radical change in the arrangements of the markets in these towns, though, in some of them, the buildings are handsome and convenient. No sight can be more disgusting than the butcher's corner, when closely, or, indeed, superficially explored. Out there in the sun, raw hides, a prey to legions of flies; up here, on dirty hooks, heads of sheep or cows, with heavy, creeping worms crawling languidly in the sockets of the eyes, and in the mouth; in another place, half putrid lungs hung up, like trophies, on steaming, dirty sticks; and everywhere unsightly lumps of unwashed meat, much of it lung-sick, to judge by the trophies overhead, but far too thickly incrusted with the black dust of the roads for the taint to be at once discoverable. Butchers, or butchers' helps, in dirty dresses, and with indescribable hands, seize these pieces of meat as soon as the market is over, throwing them into baskets which appear never to have known a scrub, and which, if scraped, would each produce a heap of solidified meat and blood, the accumulation of months, or it may be of years, of gluey stickings of meat. Outbreaks of yellow fever have been directly traced to the presence, on the roofs of houses or in the streets, of raw or half-tanned hides, festering and decomposing in the sun; and if it were not for the senseless habit of attributing every death to the climate, the great majority of fatal cases of disease might be directly traced to breaches of the commonest laws of sanitary science. With towns built on swamps, with malarious lagoons intervening between them and the pure breezes from the ocean, with impenetrable, unventilated bush shutting them off from the renovating air-currents from the land side, and with the rotting filth of a generation perpetually around them, the wonder is, not that the death-rate should be high, but that anyone should be able to resist the sum of these evil influences.

The following figures, given by the hospital authorities of Bathurst (Gambia River), tell the tale of sanitary neglect which I have attempted to reveal; but, as against the normal climate of the country, I deny their significance. They are worthy of the attentive consideration of the Central Government. During the past 20 years, the total deaths among the coloured population have been double the total number of births. The number of male deaths alone exceed, by 18 per cent., the total births of male and female children. The mortality among the males exceeds that among the females by 340 per 1,000. The highest rate of mortality is amongst infants from one year to seven years of age. Up to the age of 20, the death-rate diminishes, and then again increases to 40. Only a small proportion of the natives live beyond the age of 40. There are some Europeans, however, who have resided here for long periods. A French gentleman of my acquaintance has flourished in Bathurst for upwards of 17 years, and he has two or three compatriots, old residents. But Frenchmen are proverbially temperate—*verbum sat sapienti*.

Among the remedies to be adopted, none plays a more important *rôle* than normal bodily exercise. Exercise of a proper character maintains a normal circulation of the blood. The friction of the sanguineous globules one against another develops heat and energy, and, without doubt, electricity. Now, a tropical atmosphere is highly charged with electricity; and, unless a proportionate amount of counteracting electricity is developed in the body, a violent effect is exerted upon the nervous system, similar to that which may be produced by an electrical machine. A simple experiment in illustration of this theory would be very interesting. I think such an experiment would clearly prove that a person who is in the habit of taking, at regular intervals, a certain amount of exercise would be less able to resist the action of an electrical machine before, than after his usual exercise. It is known to everyone that the less exercise a person takes the greater is the fatigue consequent on exertion; so, in the tropics, those who take exercise the least feel most the oppression of the heat, and exhibit the least energy under it. Animals in a wild state will, after a certain rest, suddenly break forth into violent exercise, and if this, by any cause, is prevented, they soon begin to appear sickly, have a dull eye, an irregular pulsation of the heart, with respiration abnormally slow or quick, according to the nature of the sickness which the reduction of their vitality is sure to prepare them to catch. This is exactly the case with the human animal. Deprived of energy or electricity by want of exercise, his system is prepared for the attacks of fever or any other disease. A camel, ox, horse, or donkey, during, or immediately after exercise, will, sometimes, give as many as twelve electric sparks on being struck with a raw-hide whip, while, from the same animal, if deprived of exercise for a certain time, it is difficult to elicit a single spark. For a consideration, you may obtain from a negro permission to try the raw hide experiment, and you will, probably, be surprised to find that an industrious negro, on being lightly struck, will give two, and sometimes three electric sparks, while, with far greater force, you will not be able to extract a single spark from a lazy negro. On a dark night, an emanation of electricity, forming a sort of halo, may be observed round the body of a perspiring negro, resting, after vigorous labour, upon a bullock's hide, and sparks will not unfrequently be emitted from his body during his movements in sleep. Similar effects I have never observed from a native known to be lazy and afraid of work or exercise.

Moderate exercise is, again, necessary in order to maintain the fluidity of the blood. Rapid evaporation of the watery particles in the blood takes place through the strong perspiration which is the natural consequence of climatic heat, and, unless means are adopted for replacing the water, the blood rapidly thickens, and circulation is impeded. Many doctors recommend avoidance of exposure to

heat, as far as possible, and also avoidance of exercise, as the best means of preventing a too rapid evaporation of the aqueous portions of the blood; but, in spite of every device, the heat cannot be altogether avoided, and evaporation cannot be prevented. Indeed, it must not be prevented, for, without it, the skin would become parched, and, refusing to perform its functions, the blood would then be thickened by the accumulation of internal heat. Too profuse perspiration is undoubtedly exhausting, but the long absence of perspiration would cause a rapid increase in the temperature of the blood, and a condition of still greater danger would thus be speedily created. Though moderate exercise will provoke perspiration, and augment the evaporation of the watery particles, a more than equivalent quantity of moisture is returned to the blood by the quickening of the respiration which the exercise effects. With or without exercise there must be evaporation, and consequent loss of fluidity; but exercise affords a means of regulating the fluidity with the greatest nicety, and, therefore, of maintaining the normal condition of the circulation of the blood. It is calculated that, with each respiration in a moderate temperature, 1·62 cubic inches of oxygen are supplied to the lungs, and, allowing 20 respirations per minute as the average, the daily requirement of oxygen amounts to 26 cubic feet. The total amount of air for such respiration is, on the average, 20 cubic inches, which, at 20 respirations, would represent 400 cubic inches per minute. Of this quantity, 4 per cent., or 16 cubic inches would be carbonic acid. The oxygen, which is the chief constituent of atmospheric air, combining with hydrogen, supplies to the blood the watery particles required; and it is evident, therefore, that an increase of the rate of respiration by exercise will promote the circulation of the blood by increasing its fluidity, as well as by the production of electrical energy. The researches of Lehmann and of Scharling have given to science some valuable data respecting the functions of the respiratory organs, of which the enlightened student of tropical diseases should not fail to avail himself. Lehmann discovered that, in a moist atmosphere, the quantity of carbonic acid exhaled far exceeded that which the same body would give off in dry air, and that more is given off in winter than in summer. Scharling has found that the exhalation of the same vapour from the body, during sleep, is considerably less than in the waking hours. In the climate of Mid-Europe, the latter investigator observed that, for 22·77 grains of carbonic acid exhaled per hour of the night, about one-half more was given off during the same period immediately after the midday meal, the exact hourly proportions throughout the night and day being as 31·39 to 40·74. Violent exercise, under most circumstances, should be carefully avoided, but moderate exercise I most strongly recommend. White men in the tropics, whose circumstances permit them to abstain from bodily and mental exercise, are never so healthy as those whose occupations compel them to exercise both body and mind to a moderate extent. It is an undoubted fact that, in these regions, an industrious man, whether white or black, always looks more healthy than a lazy one. In dry regions much more exercise may be taken without fatigue than in damp, swampy districts, and, in the former, both men and animals are more muscular, energetic, and graceful in form than in the latter, where the natives are not unfrequently lank, tall, and attenuated.

The rule of life I would lay down for a resident of the tropics is based upon the words "diet, exercise, and energy." These are the man's climate —his life—the power of the intellect nourished by the normal blood. The rule of life adopted by most Europeans in the tropics, so far as they can be said to have any rule, appears to be "feed and rest, rest and feed." Few give any intelligent consideration to the subject of the preservation of health, and many do not even take the trouble to consult a medical man unless at some serious crisis, when, as it generally happens, the physician's aid has been sought too late. They will take quinine in absurdly large doses, literally eating it with a spoon, and calomel they consume in alarming quantities, but of the advantages of small doses the majority of the settlers appear to be profoundly ignorant. A pinch of quinine, taken at the moment when a fever attack is first perceived will be of great benefit; but this valuable drug should only be used when actually required. It is worse than useless to take it beforehand, as many do, as a precautionary remedy.

Moist heat is generally believed to be dangerous but there is every reason to think that it is not the heat accompanying the moisture which does the mischief, but the moisture alone. Dry heat is undoubtedly beneficial, and the moisture of the tropics is as certainly hurtful; but the most dangerous moment of exposure to moisture is that part of the night when it is most cool. Given two malarious towns, equally moist, and in all respects alike, except thermally, the sickness would be less in that town of the two which has the highest average temperature, and the least range of variation. The average temperature during the dry season is considerably higher than during the rainy season, yet it is the latter which is most prolific in causing disease. The most prevalent diseases at this time are dysentery, diarrhœa, cholera, and yellow fever; all, except the last, common to temperate climates. Rheumatism and gout are also prevalent, but these are generally either inherited or caused by careless exposure to damp, by debauchery, or by neglect. Goître, a swelling of the thyroid gland, is a disease much more frequently met with in the moist districts of the West Coast than elsewhere. The natural remedy for all these evils is the advent of the Harmattan winds, which, as soon as they begin to blow, change the land of mourning into a land of joy. The noxious moisture is dried up, and the sick recover as if by magic. These drying winds blow regularly from December to February.

The natives have a simple and very sensible method of warding off the pestilential moisture of the swamps. They plant groves of trees between the swamp and their villages. This is found very effectual; probably, because the trees intercept or absorb the malaria, and prevent its being projected into the midst of the population by the wind. They, at other times, burn the bush, and the soil, then becoming exposed, acquires a crust which impedes the rising of the vapour. If a little rises, it is either dissipated or largely diluted by the wind, and rendered harmless.

In the British possessions such obvious means of protection appear to be either unknown or despised. Here and there traces may be found of something in the nature of a remedial attempt; such, for instance, as the ditches constructed at George Town, to carry off the surplus water to the Gambia River. But these attempts have all proved total failures, partly from the fact that the works were constructed without sufficient data, and partly from subsequent neglect.

Let me ask:—Do the British authorities at home know of these things? Are the agents of the Government interested in the development of England's greatness, and in promoting the welfare of the subject races over which she rules? Are they interested in holding the torch of truth over these dark parts of the earth, or is it their interest to keep back the light? Are there among them men willing to spend themselves in the endeavour to plant the health and comfort of civilised communities on the neglected soil of Africa, or have they all enwrapped themselves so securely in the mantle of egotism as to be unable to look beyond their own interests?

In England, there is no lack of men anxious to learn the truth, in order that their sympathies and their benevolence may be directed upon worthy objects. But there is also, here and abroad, a class that profits by the abuse of those sympathies. The worst of these are the writers of books with sounding titles, which, under pretence of extending our knowledge of tropical countries, deceive us with accounts of pseudo or superficial travels. Such publications progagate the errors of others, do much harm to simple, but well-meaning races, and retard the progress of a mighty empire, in order that a little name may figure for a day on the title-page of a book.

DISCUSSION.

The Rev. Horace Waller wished, in the first place, to offer a tribute of thanks to Mr. Mitchinson for his paper, for the broad view he had taken of things African, and for the hopes he had expressed that a little more exercise of common sense would do away with many of the evils which had kept Europeans from that great continent. He only regretted that the author had not been able to give in more detail the result of his observations on African fevers, and their effects on different constitutions. He would venture to supplement the paper by some details gathered from his own experience, and from that of some medical men who did all they could to instil into him some medical knowledge, viz., Dr. Livingstone, Dr. Kirk, Dr. Mellor, and the late Dr. Dickenson. In Africa, there were several things absolutely necessary to be observed, in order to preserve health. In the first place, the choice of a site for a camp was very important; men often chose a nice expanse of sand, which seemed dry and clean, but nothing could be more fatal; he would far rather encamp even amongst the reeds and rushes; and Dr. Livingstone had suffered very much on some occasions from the same cause. It was probable, that during the wet season, decayed matter was brought down with the sand, and lay buried some distance below the surface, where the fierce heat of the sun caused it to ferment and give off malaria. Again, no one should camp in a hollow. In Africa, you might walk into a hollow, and feel almost as if you were going into cold water; but people sometimes fancied that being in a hollow they were sheltered. A camp should always be on rising ground. All Englishmen were fond of their tub, and many would stick to their plunge in a cold stream; but this was a mistake. Naval surgeons, &c., in the East Indies, had come to the conclusion that men must not indulge in cold bathing in the East as they did in England, and he could add his own testimony to the danger of doing so. They should be content with a bucket out of the river or stream, and sponging themselves. Then, again, the question of dress was very important. Flannel should be used, but with discretion; and, above all things, nothing should be worn tight round the neck. *Coup de soleil* was commonly caused by pressure on the large blood vessels, preventing free circulation; the kind of head covering was not of much importance, so that it was sufficiently thick. Dr. Livingstone usually wore an ordinary navy cap, and never had anything like sunstroke, except on one occasion, when the sun poured in on him through a hole in the roof of a hut where he was sleeping. It was also important that the stomach should be carefully covered with a thick waistband of some sort, which was the invariable custom of the Arabs. In the alluvial districts, where pathways had been made, the soil was very black, and the radiation of the sun's heat most intense; even the hard-footed natives sometimes could not walk on them; and on such occasions he had found that if the abdomen were not well protected, a deadly faintness would come over one, which was the premonitory warning of more serious mischief. With regard to feeding, he must join issue a little with Mr. Mitchinson. He had tried both plans, and his decided opinion, based on experience, was, that by a good supply of tea, coffee, sugar, and, above all, wheaten flour, preserved soups, meats, &c., the men now living at Livingstonia were, to a great degree, kept in good health. Of course, none of them were likely to exceed in anything, but he believed their health depended in a great measure on the commissariat. With regard to stimulants, of course the common sense of everyone agreed that they were simply destructive; in his opinion, there was nothing better than coffee, morning, noon, and night. He had taken a great deal of medicine, and had given a great deal, and he did not believe any friend of the human race was ever so much abused as quinine. The Admiralty regulations prescribed that men on the African rivers must take a dose of quinine every day; but he believed you might, by this process, beget a kind of fever in any one, make him nervous and anxious, and worry him into that state in which fever would easily attack him. You should not make men fancy they were ill, by continually looking at their tongues and feeling their pulse, but keep up their spirits as much as possible, and not give them quinine until it was wanted. If quinine would not cure fever, nothing would; but it sometimes happened that even that was of no use, unless a previous dose of calomel, to act upon the liver, had been given. There was also another medicine, of which he had no personal knowledge, but had heard it very highly spoken of, called Warburg's drops; quinine was one of the constituents, but it was combined with various aromatic essences, which were thought to have a very good effect. Next came the question of sleeping; he would not allow any man to sleep without a mosquito curtain, which he believed to be of great service in keeping off malaria. The moisture of the air became deposited in the fine meshes of the net, and acted as a screen, and it was commonly said, and he believed was the case, that malaria would not pass over water Another evil to guard against was the sudden fall of temperature, which took place early in the morning. Men went to sleep under the mosquito curtain, in the most intense heat, and slept heavily; but about four o'clock they would wake up and feel chilly, and pull the blanket over them; but it was then too late; those who said at breakfast that they had woke up chilly, would be sure to have the fever. There was a kind of dress, called, he believed, a "Laming suit," which sailors were obliged to wear at night in tropical countries, consisting

of a pair of high trousers, covering the abdomen, a sort of pea jacket, made of flannel, with a large collar which could be pulled up round the head, and this was a most excellent thing; but where this was not worn, men should accustom themselves to wake up early, before the chill came on, and pull their blanket up round them, so as to avoid taking cold.

Captain Foot, R.N., said he could endorse almost all which had been said by Mr. Waller, though, perhaps, that gentleman had been a little hard on quinine. Most of his time in the service had been spent in the tropics, India, China, Central America, the West Coast of Africa, and the East Coast, and he had had a great deal to do with fever. He had had most of the West Coast fevers, including yellow fever; but his last trip was to Zululand, where he joined the Naval Reserve, and from there he went up to Zanzibar, and back again, and had no fever at all. He followed the advice of a naval surgeon, and for ten days or a fortnight previously, took a moderate dose of quinine, which he thought acted as a protection. He also agreed with Mr. Waller that good living was essential. In hot climates there was a great drain on the system, both physical and mental, and even moral, and the meat afforded by the goats, sheep, and fowls of the country was not, in his opinion, sufficiently stimulating to the digestive organs. Preserved meats and Kopf's essences were of great value, therefore, to the traveller. A mosquito curtain was no doubt a filter to the malaria, and he would sooner go without his whole baggage than miss it, although, fortunately, mosquitoes did not hurt him. The "Laming suit" was a very good thing, light, cheap, and easily made; and he knew, from experience in India, that a sudden fall of temperature occurred in the early morning. He thought regularity of meals a great advantage where it could be obtained. With regard to stimulants, the men had their usual allowance of rum, and when they were boat cruising a double allowance, with sometimes the quinine mixed with the rum, or a little sherry. They looked forward to these little things, and he thought it did them good; they did not, of course, get it in the heat of the day. It was a great thing to keep men cheerful and in good spirits; as he often told them, a good laugh would do them more good than all the quinine. If persons were not accustomed to stimulants, of course, they would be better without them, but those who were used to take them in moderation, were, he thought, wrong to drop them suddenly on going to a hot climate. Wherever it is practicable, as in the case of fixed stations, distilled water should invariably be used for domestic purposes. Mr. Harvey, the chief engineer of the *London*, has suggested two very excellent forms of condensing apparatus, for the preparation of distilled water at stations. The mind had a great deal to do with all these matters, and allowance must be made for habit. He hoped this paper would be the means of showing that Africa was not nearly so black as it was painted, but that it was a country in which Europeans could live quite as well as in India.

Dr. Thin said this subject was one which came constantly before him in the course of his practice, and he was the more interested in it from having practised some years in China. He had been pleased and instructed, both by the paper and Mr. Waller's remarks; but one thing must strike every one who had listened. There seemed a consensus of opinion that if you took certain precautions you might go to these countries and live there with comparative safety, but then, what a number of precautions you had to take, which no one ever thought of if they went to Germany, Canada, or France. The very fact, that most experienced men found it necessary to take these precautions, showed at once that you were running great danger, and that if you made the slightest slip in yonr mode of life you might die. This was not only a matter of fact, but it was his firm conviction, and it was confirmed by the practice of all life assurance societies; and his opinion, which was confirmed by his practice in London, was, that these climates were all bad, and that if any man thought his health was the first object, and he wanted to live as long as he could, he should never go to any of these climates, because he would certainly run risks which he would not by remaining at home. A physician in London, of great experience in the diseases of women and children, informed him that he could at once tell when he saw a European child, born in India, come into his consulting-room, without asking a question; and he (Dr. Thin) could almost do the same. If you wanted to test the healthiness of a country or an occupation, you did not choose a strong, vigorous man who went into it in the prime of life, and left it after four or five years, but you took a weak man, and if he could not stand it, you said here is a country or an occupation only fit for the strong and vigorous. There were men born that nothing would kill short of actual violence; some could go to India to live to 80. With regard to diet, his conviction was that the less people thought about what they ate and drank the better. Nothing astonished him more than to find people coming to him, very often young men, asking him what they should eat. The best thing was for people to live in a quiet, orderly, regular way—very much as they did at home. It was utterly useless to attempt to follow the example of the natives, whose constitutions had never been accustomed to the food and habits that Europeans employed. When in China, he recollected people who had consulted physicians before they came out as to the best way of living in a tropical climate, and they often had very bad advice, which made them ill. They were told not to eat animal food, but to eat rice; they got ill, anæmic, and fell victims to their intense prudence. With regard to quinine, he believed it would no more prevent a man having fever, if he took it before he was exposed to malaria, than taking an antidote for arsenic to-day would prevent his being poisoned by it next year; but quinine would act as a prophylactic in this way. People who lived in malarious countries imbibed the poison into the system without having fever, but they might come back to this country, and on getting wet and chilled, have an attack of ague. Only last summer, a gentleman went to Borneo for a few months, and returned; he had no fever out there, but when he landed at Marseilles he took cold, and had a severe attack of ague. Very possibly, if he had taken quinine on the island, it would have counteracted these effects. When a man had the fever, there was nothing for it but to get the quinine into him as soon as possible. But there was no doubt that the habitual use of the drug had very great disadvantages; one was, that it certainly injured the hearing, and it certainly produced nervous disorders; therefore, if a man could not live in one of these countries without taking five grains of quinine a day, the sooner he got out of it the better. One peculiar symptom produced by quinine in some people he had never seen noticed; but he had a patient at the present time who, if he did not take a warm and generous meal within ten minutes after a very moderate dose of quinine, trembled, and became faint, and exceedingly ill. With regard to the use of alcohol, they all knew it was used freely in all these countries, and he believed it always would be; for the simple reason that the depression and exhaustion which made people resort to it here, were perpetual there. Men worked 12 and 14 hours a day, both physically and mentally, and when meal-time came they had no appetite. But they had more work to do, and must eat, and therefore they took brandy and soda, or some effervescing drink with alcohol in it, a cocktail or something, and then they were set up and could eat. At the same time he was satisfied that doing this from day to day, and month to month, laid the seeds of arterial degeneration, degeneration of the heart, exhaustion of the system in many ways, and of anæmia. They found out there men of 40 suffering from the diseases of 70 in Europe. Alcohol might

help them over the day; and they could not always afford to consider what was most conducive to longevity, but it was in the long run pernicious. With regard to the danger of suddenly discontinuing alcohol, he had some experience when abroad. Ladies suffered much more from the climate than men—another sign of the badness of the climate—and they naturally resorted, as other people did, to stimulants; frequently it was ordered by the doctor, and by and bye they fell into the habit of taking it. He found this in his own practice, and was alarmed at it. He made it a rule, whenever he saw any bad result, simply to say stop taking alcohol in any shape or form, and in every instance in which he gave that advice, it was followed with benefit to the health. There might be hysteria, tears, depression, and so on for a week or two, but at the end of a few months the patient always said it was the best advice she had ever had in her life. *Delirium tremens* was not uncommon in these countries, and it was very fatal—another sign of the badness of the climate. In such cases he always made it a rule to stop alcohol immediately, and almost invariably the patient's life was saved. Naturally, in these countries, there were few abstainers, but amongst the few he knew the health was excellent.

Dr. Mann said the principal object of the paper appeared to be to show that the main causes of disease in tropical countries were preventible, and with that he cordially agreed. There could be no question with anyone, who had seen much of warm climates, that very much of the disease which was experienced was due to personal habits, which were within control. On the other hand, there could be no doubt that serious and grave diseases did sometimes come in tropical climates, after long exposure, to those who lived the best lives men could live. There was no argument that tropical countries were healthy places, but it must be remembered there were unhealthy countries to which men were led by a sense of duty, feeling that they had opportunities of usefulness there which they had not at home: and when they did go, it was surely important that they should go with a strong conviction in their minds that if they learned to do their duty well and fairly, instead of badly and unfairly, their chance of carrying their work through to a successful end would be much greater. That was really the gist of Mr. Mitchinson's argument. He was convinced that the truth would be found to be essentially in the mean, and not in either extreme. We must take the rules of common sense and apply them as far as possible. A great thinker had defined science as organised common sense; that was a good definition, and practical men ought constantly to strive so to organise common sense as to bring it to bear on the work which lay around them in daily life.

Mr. Hyde Clarke said he had been much struck with Mr. Mitchinson's allusion to the systematic practice in Africa of planting trees so as to intercept malaria. He had himself never known of that being done, but he did know an instance of a converse case, where a large village, of about 400 stone houses, had been deserted for 60 years, no one being able to live there in consequence of a grove of trees, which had sheltered it from malaria, having been cut down. It was very important in selecting a site for a camp or station to note the prevailing winds, and not to choose a spot exposed to miasmatic influences. It was also important to avoid cultivation too close to the station; and he had little doubt that the difference in the health of the different regiments in Cyprus were caused by the ground being broken up more in one camp than another. He remembered a case where a town was built in a healthy situation, and where the people were free from fever for two years; but in the third, it broke out at one end and went through the whole place, simply because some Englishmen thought it was a pity such good soil should be uncultivated, and, contrary to the regulations, got planting potatoes or something of the kind. He remembered when Dr. Livingstone appeared once in that room, he had to apologise for his unfamiliarity with English, like Mr. Mitchinson, from having been so unaccustomed to it; but he must say he did not think the administrative authorities on the West Coast were all quite so neglectful of sanitary measures as Mr. Mitchinson seemed to imply. Mr. Pope Hennesey was certainly not unmindful of the welfare of those over whom he was placed, though he was not long continued in his African government; and he thought great consideration should be shown to the men who undertook such responsible and dangerous duties.

The Chairman said it appeared that Mr. Mitchinson attached very little importance to what were termed meteorological changes, which he looked upon as rather incidental to bad health and mortality than anything else, and that he considered the main causes of mischief were bad sanitary conditions, and improper food. Then he mentioned certain physiological facts, which were of great interest and importance, and thence he had gone on to suggest remedies for tropical diseases; and, finally, he had referred to the great carelessness which existed on this question. On some of these points the preceding speakers had not touched at all; for instance, the physiological facts, and the carelessness of the public, had only been referred to by Mr. Hyde Clarke, who, to some extent, vindicated our public men from the charge of indifference in this matter. Some facts were of leading importance, and about them there was no difference of opinion. Thus, with respect to the use of alcohol, everyone spoke with some authority from experience, and all bore evidence on one side; for Capt. Foot had spoken with extreme qualification as to the use of alcohol at all, admitting that it should only be employed by those to whom it had become, not physically, but morally, a necessity; and those whose experience lay in the metropolis, often met with the same class of cases, to whom they were obliged to allow it, for the same fancied reason. Barring this one objection, there was a consensus of opinion that in tropical climates the effects of alcohol in every form were ultimately prejudicial, and that there, at all events, alcohol could not be accepted as a food. He might say, incidentally, that if they had been speaking of the Polar regions, the same argument would just as well obtain; and if they turned to their own country, and looked at what had been going on during the past few weeks, they would see again the same story. During the extreme strain to which people had been subjected, by the astonishing condition of cold, combined with wet and fog, no enemy had been found so fatal in combination with this as alcohol. There were one or two points on which some speakers seemed somewhat at variance, but in reality were not so. For instance, on the question of meteorology, Mr. Mitchinson took a different view altogether to Dr. Thin, but both were, to a certain extent, right; because in the use of the word miasma, which the former introduced freely, he admitted the influence of meteorological conditions. You could not conceive of miasmatic conditions without bringing in meteorological, whatever view you took of the nature of miasma—whether you considered it a particular change in the substance of the body—a living substance, as some supposed—or, as Mr. McLaren suggested some years ago, as being nothing more than a peculiar condition of water in the atmosphere. But there was a great deal to be said with regard to meteorological changes as affecting the condition of the individual. There were changes, of which, at the present time, we had no direct knowledge, which influenced us irrespective of our mode of life. The large number of sudden deaths which had occurred of late could be attributed to nothing but atmospheric conditions. Certain seasons were connected with certain diseases. Some time ago, he published an essay on this subject, in which he showed, among other facts,

that scarlet fever doubled in mortality from November to February, as compared with its mortality from May to August. Even if there were the same number of cases in the summer months, there would be a much lower mortality over a range of years than in the colder ones. Again, we did not live in the same way during one season that we did in another. In November, we all began to lose in weight, and went on wasting until May, when we began to increase. In November also we began to give off more carbonic acid; in the winter our venous blood was intensely dark compared with the arterial, but during the summer we could scarcely distinguish the difference by the colour, and in the tropics could not do so at all. The late Dr. John Davy, when living in India, actually sent home a paper to disprove that there was any difference in colour between the arterial and venous blood, not conceiving it possible that there should be so much difference in oxidation in the tropical as compared with the colder climate. He had himself once traced out the ratio of mortality, after great surgical operations, in reference to meteorological changes, and found that with a falling barometer there was a higher mortality than with a rising barometer and a dry atmosphere. They could not therefore throw over meteorology, though that in no way clashed with the conclusions drawn as to bad sanitary conditions and bad feeding. As Dr. Thin had said, in tropical regions there was more strain and exhaustion, and we had to consider, with more care than we need here, the way in which we lived, just as more care must be taken here than in Mexico, Colorado, and some other places where exceptionally equable conditions prevailed. With regard to the power of the human body to bear climatic changes, he might draw attention to the case of the Jews. Michael Levy, the great hygeist, declared that a Jew could live anywhere, and wrote a paper on the subject; but if the proper explanation were arrived at, he believed it would be found that they lived in tropical countries better than the rest of the world, simply for the same reason that they lived better in Frankfort, London, or elsewhere; they lived much more simple lives; they were notoriously temperate in the use of alcoholic drinks, and were frugal and carefnl in the matter of food. Whether the Jews would continue to enjoy the same advantages now that they were getting richer and more luxurious, he was inclined to doubt. Mr. Mitchinson had referred to the possibility of building cities or towns anywhere, and he largely agreed with that view. Some of the figures he had quoted showed that, even in the tropics, the mortality was very little in excess of many towns in England. In Liverpool it had been nearly as high as at Bathurst on the Gambia. If he had money and command of engineering skill without limit, he could build a "Hygeia" anywhere where there was a good foundation, where food could readily be obtained, and where roads could be constructed. Any part of the earth's surface could be made the site for a model city, and that would be the work of the future, perhaps. If, as Dr Maudsley suggested, the earth cooled down, so that our posterity had to live in snow huts near the Equator, it would become a question how these equatorial cities should be built. Several of Mr. Mitchinson's physiological statements were somewhat crude, though interesting. He was not sure that he knew what he meant by the oxy-hydrogen produced in the body, nor the combination of oxygen and hydrogen in the body. He assumed that he probably referred to some experiments which had been made to endeavour to prove the oxidation of hydrogen in the body, but that discovery had yet to be confirmed. It was at present only a speculation, arising from a calculation that the amount of water taken as food in various ways was not sufficient to form the 75 per cent. of which the body was composed. Again, with regard to the electrical phenomena mentioned, he had never heard of such things having been observed. Some experiments had been attempted, tending to show that, during or after exertion, the body was positively electrified as compared with the atmosphere, and when in a state of exhaustion, negatively, and these experiments, which were conceived many years ago, had been too much neglected; it was also possible that some electric change took place connected with the presence of the water in the atmosphere, when the body got very much depressed in the presence of aqueous vapour; but as yet these were only speculations, stimulating inquiry, and not standing on any experimental basis. He agreed with Mr. Mitchinson as to the dense condition of the blood, which resulted from extreme heat. If the water were removed in large quantities, the blood became, not coagulated, but inspissated, and ready to take up a large quantity of water; and under these circumstances, its vital power was lowered. A remarkable instance of this occurred some time ago, in the practice of a noted physician in Dublin. A woman under his care suffered just the same as if she were in in a tropical climate. She was constantly perspiring, relaxed, and faint. After death she was found to have a peculiarly diseased condition of the heart, by which the oxidised blood, after it had come from the lungs into the left side of the heart, passed back into the veins by an opening in the heart itself; so that she was always having extremely oxidised blood distributed over her body. In such a condition, a free but not excessive quantity of drink should be taken. Exercise was also beneficial, as it no doubt led to a greater determination of food towards the blood; and, lastly, under no circumstances, should a large quantity of water be taken when the blood was in a dense condition. He concluded by moving a vote of thanks to Mr. Mitchinson for his paper.

Mr. William Botly, in seconding the resolution, said he was acquainted with a Major-General who had served 21 years in India and tropical climates, but who never took alcoholic drinks. He was now about 60, and went through a day's walk or any kind of exercise with as much zest as a young man.

The resolution being passed,

Mr. Mitchinson, in reply, said he regretted that he had not had time to develop the physiological aspect of the question so fully as he should have liked, and as he hoped to do on some future occasion. He did not, however, mean to say that meteorology had nothing to do with the question of health in tropical climates, but that it had much less than other controllable influences.

ELEVENTH ORDINARY MEETING.

Wednesday, February 18th, 1880; Field-Marshal Lord Strathnairn, G.C.B., G.C.S.I., in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, Chas., 60, Francis-road, Edgbaston, Birmingham.
Heaton, Charles W., F.C.S., Charing-cross Hospital, W.C.
Hoe, C., 44, Leadenhall-street, E.C.
Mole, Frederick M., Granville-street, Birmingham.
Moon, Ernest Robert, 2, Temple-gardens, E.C.
Plant, George William, 145, Queen Victoria-street, E.C.
Parkes, Sir Harry Smith, K.C.B., H.B.M. Minister, Japan, and Athenæum Club, S.W.
Underhill, Arthur, M.D., Great Bridge, Tipton.

The following candidates were balloted for and duly elected members of the Society:—

Archbold, Ralph S., 2, New Broad-street, E.C.
Batty, Edmund, 2, Eslingden-terrace, York.
Berens, Rev. R. M., Sidcup.
Jones, Rev. Alfred, 117, Gunnergate-terrace, Middlesbro'.

Jones, William John, 7, Great George-street, S.W.
Love, Alfred, Old Shot Tower Wharf, Commercial-road, Lambeth, S.E.
Marlow, Thomas, Thorncliffe Iron Works, Sheffield.
Rutherford, J. H., School of Science and Art, Corporation-street, Newcastle-on-Tyne.
Sexton, Joseph, 3 and 4, Great Winchester-street, E.C.

The paper read was:—

EUPHRATES VALLEY ROUTE TO INDIA.

By W. P. Andrew.

Seldom has the public mind—I may say that of Europe—been so completely engrossed as at this moment by the Central Asian question, owing rather to the magnitude and uncertainty of events, to which it may at a future time give rise, than to its more immediate and palpable consequences.

Here, in England, it is not surprising that the recent movements of Russia—taken in conjunction with the position in Afghanistan of our heroic countrymen and their gallant brothers in arms, whether Mohammedan or Hindoo—should excite men's minds, and should make us more determined than ever for the maintenance of our *prestige* in Europe and the safety of our Empire in the East. But while, in our desire to avoid political complications, we have devoted ourselves, with much assiduity, to the discussion of minor geographical questions, we have overlooked the simplest and most obvious means of checkmating the possible designs of Russia, by closing the gates of India, the Bolan and the Khyber, and by a parallel movement along the Valley of the Euphrates. It is right, therefore, at the present juncture, once more to invite attention to the proposed establishment of a direct and rapid route to our Eastern possessions, by the ancient highway of the Euphrates.

In the proposal to restore this ancient route—once the highway of the world's commerce, and the track of the heroes of early history—by the construction of a railway to connect the Mediterranean and the Persian Gulf, we have at hand an invaluable and perfectly efficient means at once of thwarting the designs of Russia, if they should assume a hostile character; of marching hand-in-hand with her, if her mission be to carry civilisation to distant lands; and of competing with her in the peaceful rivalry of commerce.

Of all the lessons which recent wars have taught us, none is more emphatic than this, that henceforth the power of nations must be upheld by the knowledge and use of mechanical appliances. Among the most important of these are railways, as we saw in the Franco-German war. A vague presentiment of this marvellous revolution had long existed, but it had to struggle against apathy and deep-seated prejudice. The true secret of national supremacy has, however, now been brought home with irresistible force to the most reluctant mind; and it behoves us to brace ourselves anew for a more determined progress, if we would retain the prestige and influence we have hitherto enjoyed as a great nation.

In the Crimean war we saw, with certainty, where the power of the Czar first gave way. The telegraph and rail were the missing links in his armour. He had built fortresses of colossal magnitude, collected resources astonishing from their variety and abundance; his generals were selected with consummate skill, while over the persons and and property of his subjects he exercised unlimited control. But, had the Czar been able to whisper his commands with lightning speed, and been obeyed with promptitude, how different might have been the result! The giant aggressor was, by a handful of invaders, with telegraph and steam in connection with the bases of their operations, defeated and humiliated on the soil of holy Russia herself.

We all now know how alive Russia has now become to the necessity of following up her advances by improved means of communication. It is inconceivable that any power but England, having either means or credit at command, would hesitate how to act under such circumstances as those in which we are placed. To us it has been a continual reproach that we are never ready for the emergencies which we might readily have foreseen. Let us not refuse, therefore, to learn wisdom by the experience of the past, or some day we shall assuredly be called on to spend untold treasure to retrieve disasters which a little timely forethought would have enabled us to avert.

Few facts bear more conclusive testimony to the sagacity of the ancients, when the limited amount of their geographical knowledge is remembered, than the tenacity with which commerce adhered to the direction given to it by them, and the readiness with which it returns to any of those channels when temporarily diverted by political events, or geographical discoveries. The overland route from Europe to India, by the Isthmus of Suez and the Red Sea, is certainly as old as the days of the early Phœnician navigators. The navigability of the Euphrates was tested long before Trajan ever sailed on its waters, and was re-visited by the Italians in the eleventh century, and our own merchants in the days of Elizabeth, as the best way to the East; whilst the value of the Indus, as the shortest and easiest route for the commerce of India, not only with Central Asia and the North of Europe, but with the whole of the West, was fully recognised by the later Romans in the seventh century. When the rapid progress of the Mohammedan arms had wrested Egypt from the Byzantine power, and thus closed the overland route of Suez to the Greek merchants, they forthwith turned to other means, and sought out a new channel by which the productions of the East might be transmitted to the great emporium of the West. The route thus discovered was that by the Indus. The rich and easily stowed products of India were carried up by this great river, as far as it was navigable, thence transported to the Oxus, down whose stream they proceeded as far as the Caspian Sea. There they entered the Volga, and sailing up it, were carried by land to the Tanais (the Don), which conducted them into the Euxine Sea, where ships from Constantinople waited their arrival.

Various causes concurred in restoring liberty and independence to the cities of Italy. The acquisition of these roused industry, and gave motion and vigour to all the active powers of the human mind. Foreign commerce revived, navigation was attended to and improved. Constantinople became the chief mart to which the Italians resorted. There they not only met with favourable reception, but obtained such mercantile privileges as enabled

them to carry on trade with great advantages. They were supplied both with the precious commodities of the East, and with many curious manufactures, the product of ancient arts and ingenuity still subsisting among the Greeks. As the labour and expense of conveying the productions of India to Constantinople, by that long and indirect course which I have described (the route by the Indus, the Oxus, the Caspian, and the Volga), rendered them extremely rare, and of an exorbitant price, the industry of the Italians discovered other methods of procuring them in greater abundance, and at an easier rate. They sometimes purchased them at Aleppo, Tripoli, and other ports on the coast of Syria, to which they were brought by a route not unknown to the ancients. They were conveyed from India by sea, up the Persian Gulf, and, ascending the Euphrates and Tigris, as far as Bagdad, were carried by land across the desert of Palmyra, and from thence to the towns on the Mediterranean.

The discovery of the long but easy route by the Cape of Good Hope, combined with the deadly feuds between the Christians of the West and the Mohammedan nations that held the countries of the Nile and the Euphrates, for a time diverted the stream of commerce from those routes. It has not been so, however, with the Indus to the same extent. If the revival of the Overland Route, and the impending re-opening of the Euphrates as the highway to the East, are evidences of a return to old paths, the continuance of a commerce with Central Asia and Northern Europe by way of the Indus, and the two great gates of India, the Khyber and Bolan Passes, is a pregnant proof of the tenacity with which trade adheres to its old channels, and of the sagacity which originally selected that direction for the produce of the East. However great may have been the changes of masters and manners in the territories between the Indus and the Bosphorus, a portion of the tide of commerce has flowed, and does still flow, as it did in the seventh century.

When the late Sir Alexander Burnes was in Lahore, in 1831, he found English broadcloth sold in the bazaar that had been brought, not from Calcutta, but from Russia; and, when he penetrated further into Central Asia, met, at Bokhara, with a merchant "thinking of taking an investment of it to Loodhiana, in India, where he could afford to sell it cheaper than it was to be had there, notwithstanding the length of the journey."

The countries which our future highway to India will traverse have been, from remote antiquity, the most interesting in the world. On the once fertile plains, watered by the Euphrates and Tigris, the greatest and most glorious nations of antiquity arose, flourished, and were overthrown. The earliest home of the genius of civilisation—the scene of great events in the early history of the world, now shrouded in the dust of ages, or dimly discerned through the long vista of many centuries—the land of the Assyrians, Babylonians, and Chaldeans; where the daughters of Zion sat and wept; where lay the track of Xenophon and his heroic 10,000 Greeks—the centre of the conquests of the Macedonians; where once stood the proud capitals of the Sassanides and of the Caliphs, now deserted and tenantless—these regions must ever possess a fascination and interest for all mankind.

The first city of the new earth was built upon the banks of the "Great River." The tower of pride, erected by the post-diluvian population, cast a shadow over its waters. The Euphrates intersected Babylon, the "Golden City," the "Glory of Kingdoms," the great capital of the Chaldean Empire—now a desolation among the nations, her broad walls utterly broken, her high gates burnt with fire. With Babylon are associated the names of Nebuchadnezzar and Belshazzar, of Daniel and Darius, of Cyrus and Alexander. The grand prophet of the captivity, and the energetic apostle of the new era, had their dwelling within her walls. Ere even a brick was made upon the Nile, Nineveh and Babylon must have had thriving and busy populations.

Twice in the world's history, mankind commenced the race of civilisation on the Mesopotamian rivers. Twice the human family diverged from their banks to the east, the west, and the north. Arts and sciences made the first feeble steps of their infancy upon the shores of these rivers. Very early in history we know that Babylon was a great manufacturing city, famed for the costly fabrics of its looms. At a more recent date, the Chaldean kings made it a gorgeous metropolis; Alexander of Macedon made it the port of the Indian Ocean and the Persian Gulf, and he proposed to render it the central seat of his imperial power.

The countries through which the Euphrates flows were formerly the most productive in the world. Throughout these regions, the fruits of temperate and tropical climes grew, in bygone days, in profusion. Luxury and abundance were universally diffused. The soil everywhere teemed with vegetation. Much of this has since passed away. Ages of despotism and misrule have rendered unavailing the bounty of nature. But the land is full of hidden riches. The natural elements of its ancient grandeur still exist in the inexhaustible fertility of the soil, and in the chivalrous character and bearing of many of the tribes; and the day cannot be far distant when it is destined to resume its place amongst the fairest and most prosperous regions of the globe.

The wondrous fertility of Mesopotamia was, in early times, carried to its utmost limit by means of numerous irrigation canals, with which the country was everywhere intersected, and some of the largest of which were navigable. These excited the wonder and interest of Alexander the Great, who, after his return from the conquest of India, examined them personally, steering the boat with his own hand. He employed a great number of men to repair and cleanse these canals.

Herodotus, speaking of Babylonia, says:—

"Of all the countries I know, it is, without question, the best and the most fertile. It produces neither figs, nor vines, nor olives; but, in recompense, the earth is suitable for all sorts of grain, of which it yields always 200 per cent., and, in years of extraordinary fertility, as much as 300 per cent."

These regions need only again to be irrigated by the life-giving waters pouring down, ever cool and plentiful, from Arrarat—that great land-mark of primæval history, now the vast natural boundary-stone of the Russian, Turkish, and Persian empires—to yield once more in abundance almost every-

thing that is necessary or agreeable to man. Many acres, now wasted, might be covered with cotton, tending to the employment of the millions of spindles of our land.

It is not too much to say that no existing or projected railroad can compare in point of interest and importance with that of the Euphrates Valley. It will bring two quarters of the globe into juxtaposition, and three continents—Europe, Asia, and Australia—into closer relation. It will bind the vast population of Hindustan by an iron link with the people of Europe. It will inevitably entail the colonisation and civilisation of the great valleys of the Euphrates and Tigris, the resuscitation, in a modern shape, of Babylon and Nineveh, and the re-awakening of Ctesiphon and Bagdad as of old.

It is by distance and difficulties of intercourse that the distinctions of creeds and races are chiefly upheld. Annihilate space, and the great barriers that separate peoples—the differences of manners and customs, of modes of thought and feeling, of doctrines and dogmas, of precepts and prejudices, that keep up these barriers—gradually disappear, as barbarism, superstition, and ignorance give way to the superior and irresistible force of civilisation, truth, and enlightenment.

Although various routes have been suggested with the view of bringing Great Britain, by means of railway communication, into closer connection with India and her other dependencies in the East, and of securing, at the same time, the immense political and strategic desideratum of an alternative highway to our Eastern possessions, there is none which combines in itself so many advantages as the ancient route of the Euphrates—the route of the Emperors Trajan and Julian, in whose steps, in more recent times, the Great Napoleon intended to follow, when the Russian campaign turned his energies in another direction.

The special advantages which render this route superior to all others are briefly these:—It is the most direct route to India. It is the shortest and the cheapest, both for constructing and working a railway, so free from engineering difficulties, that it almost appears as though designed by the hand of nature to be the highway of nations between the East and the West; the most easily defensible by England—both of its termini being on the open sea; and the most likely to prove remunerative.

Both from an engineering and a political point of view, the Euphrates route undoubtedly possesses great advantages over any of the others which have been proposed. All the routes which have been suggested from places on the Black Sea are open to the fatal objection that, while they would be of the greatest service to Russia, they would be altogether beyond the control of Great Britain, while the engineering difficulties with which they are surrounded are, of themselves, sufficient to exclude them from practical consideration.

This has been fully established by the evidence of the witnesses examined by the Select Committee of the House of Commons, which, in 1872, investigated the merits of the various proposals for connecting the Mediterranean and the Black Sea with the Persian Gulf.

In the course of the investigation by the Committee, it was conclusively demonstrated that the proposed Euphrates Valley Railway is an eminently feasible undertaking in an engineering sense; that the route of the Euphrates and the Persian Gulf is decidedly preferable, in respect of climate, to that of Egypt and the Red Sea; that, as regards the safety and facility of the navigation, the Persian Gulf also has by far the advantage; that the proposed undertaking would be of great commercial moment, and, if not immediately profitable, at all events, that it would be so at a date not far distant; and, finally, that it would be of the highest political, and strategic importance to this country.

It is unnecessary to quote in detail from the evidence taken by the Committee, but, in order to show how authoritative were the conclusions in favour of the undertaking aimed at by the Committee, I may state that the engineering facilities which exist for the construction of a railway from the Mediterranean to the Persian Gulf were demonstrated by the evidence of the late General Chesney, the veteran explorer of the route, by Captain, now Admiral Charlewood, of the Royal Navy, and Mr. W. F. Ainsworth, two of the officers attached to the Euphrates Expedition; by Sir John Macneill, Mr. Telford Macneill, Mr. W. J. Maxwell, Sir Henry Rawlinson, Captain R. F. Burton, and Captain Felix Jones. The advantages of the route, in respect of the climate and productiveness of the country to be traversed, were shown by the evidence of General Chesney, Mr. Eastwick, M.P., Captain Felix Jones, General Sir Henry Green, Colonel Malcolm Green, Mr. Consul Barker, and others. Mr. Barker, who had resided twenty-six years as Vice-Consul and Acting Consul at Seleucia, Antioch, and Aleppo, and has, perhaps, as intimate an acquaintance with the country as any man living, stated in an official report, addressed by him to Lord Granville, that—

"A railway through Mesopotamia, as a route to India, would not, at first, be productive of much income to a company from traffic, but in a few years—certainly before the railway could be finished—the cultivation of grain would increase a hundredfold, and would go on increasing a thousandfold, and would attain to a magnitude and extension quite impossible to calculate, because bad harvests are almost unknown in these parts, for there is always plenty of rain and a hot sun to ripen the corn. Populous villages would spring up all along the line, as there is abundance of sweet water everywhere. Cereals can be grown there so cheaply that no country the same distance from England—say, for instance, Russia—could compete with it at all. And, if Great Britain finds it necessary to rely more on the importation of foreign corn, where could a better field be found than the fertile plains of Mesopotamia, the cradle of mankind, which has all the advantages of climate, soil, sun, and water in its favour."

The facility of the navigation of the Persian Gulf was testified to by Mr. William Parkes, Consulting Engineer to the Secretary of State for India for Kurrachee and Madras harbours, and also in a correspondence published by Captain A. D. Taylor, late of the Indian Navy. Mr. Edwyn Dawes gave some useful information of the great extension of commerce at all the ports of the Persian Gulf.

The advantages of the proposed undertaking from a military point of view were placed beyond question by the evidence of General Chesney, of Captain Tyler, R.E., and of those experienced soldiers, Sir Henry Green and Colonel Malcolm Green, and more especially by the weighty testimony of

Field-Marshal Lord Strathnairn; while its importance in a political sense was established by many witnesses, amongst whom I may instance Sir Bartle Frere, the late lamented Sir Donald McLeod, Mr. Palgrave, Colonel Herbert, her Majesty's Consul-General at Bagdad, Mr. Eldridge, Consul-General at Beyrout, and, pre-eminently, the "Great Elchi," the venerated Lord Stratford de Redcliffe.

Other nations, whose interests in the East are incomparably less than ours, either on political or commercial grounds, have, in recent years, made great advances in extending their communications in an easterly direction.

The establishment of steam communication by the Messageries Maritimes on the route of the Red Sea, to Calcutta and other Eastern ports, shows the importance attached by the French to the extension of their commercial relations with the East. A Russian line of steamers has been established, to run between Odessa and Bombay by the route of the Suez Canal, and the Italians and Austrians are actively competing for a share in the Eastern trade. Even those who see no danger in the policy of annexation pursued by Russia, will admit that the Russian roads and railways now being pushed towards Persia and Afghanistan, if designed with pacific intentions, prove, at all events, the anxiety of the Russian Government to compete with us for the trade of Central Asia, the Punjaub, and Northern India. But the carriages and trucks ostensibly designed for peaceful and commercial purposes are so constructed, as to be equally available for the conveyance of troops with munitions of war.

It behoves us, therefore, to be careful that we do not stand still in the career of improvement, and be left behind in the race by other nations, however friendly. Political disturbance in Europe might at any moment, deprive us of our communications with India *viâ* Egypt. The canal, glorious work as it is, might be suddenly rendered useless. So long as the Indian Empire subsists, the connection between India and this country must be kept up. If that connection were interrupted for many months, the integrity of our Eastern Empire might be seriously menaced. England maintains her position in India mainly by force of arms; and it is a principle, both of war and of common sense, to take the most efficient means at our command to keep open the lines of communication between the base and the field of operations. Hence the necessity of establishing an alternative route, even if it were not a better one. But that by the Euphrates, the most ancient of all, is at once the shortest, the easiest, and the safest, and it can never be superseded by any other offering superior advantages.

Apart from the general question of the advantage, on strategic grounds, of possessing an alternative and accelerated route to our Eastern dominions, it is a matter of the greatest importance that, in case of an emergency we should be able to send troops to India at any season of the year. Viewed in this light, the Euphrates route presents a striking contrast to that *via* Egypt, which, during a portion of the year, could not be used for the transport of troops without a serious sacrifice of life, in consequence of the excessive heat of the Red Sea. The Euphrates route, on the other hand, would be available for this purpose at all seasons.

The substitution of Kurrachee for Bombay as the European port of India would, even by the Red Sea route, give us an advantage of some 500 miles; but, if the Euphrates route were once established, the adoption of Kurrachee as the European port of India would necessarily follow, and India would thus be brought upwards of 1,000 miles nearer to us than at present; while, during the monsoon months, the gain would be still greater, as the route between the Persian Gulf and Kurrachee is not exposed to the severity of the monsoon, which, it is well known, renders a divergence of some 500 miles necessary during a portion of the year on the voyage from Bombay to Aden. Kurrachee is now in railway connection with Lahore and Calcutta, and, when the railway system of the Valley of the Indus is completed as far as the Bolan and Khyber Passes, and extended to Candahar, the safety of India would be ensured.

May I be permitted to repeat the words which I ventured to urge upon Lord Palmerston upwards of twenty years ago, when I accompanied, in support of the Euphrates Valley Railway, one of the largest and most influential deputations that ever waited upon a Minister:—

"The grand object desired is to connect England with the north-west frontier of India by steam transit through the Euphrates and Indus Valleys. The latter will render movable to either the Khyber or the Bolan, the two gates of India, the flower of the British Army cantoned in the Punjaub; and the Euphrates and Indus lines being connected by means of steamers, we should be enabled to threaten the flank and rear of any force advancing through Persia towards India. So that by this great scheme the invasion of India would be placed beyond even speculation, and it is evident that the great army of India of 300,000 men being thus united to the army of England, the mutual support they would render each other, would quadruple the power and ascendancy of this country, and promote powerfully the progress, the freedom, and the peace of the world."

The Euphrates and Indus lines together would, moreover, secure for us almost the control of the trade with Central Asia, enabling us to meet Russia, our great competitor in these distant fields of commercial enterprise, on more than equal terms.

But it is not on commercial considerations that I would urge the claims of the Euphrates Valley Railway. It is on imperial grounds that the scheme commends itself to our consideration. I believe that the establishment of the Euphrates route would add incalculably to our prestige throughout Europe and the East, and would do more to strengthen our hold on India than any other means that could be devised.

Although fully alive to the vast importance of the results which would accrue, not only to England and India, but to the cause of civilisation generally, from the establishment of continuous railway communication between Europe and India, I cannot conceal from myself that such a project is too vast to be at once undertaken with any hope of success. But the Euphrates Valley Railway, as proposed, from the Gulf of Scanderoon to the Persian Gulf, has been specially designed with a view to its ultimately forming part of a through

line from Constantinople to the head of the Persian Gulf, while it is capable, also, of being, in due time, extended eastward to Kurrachee, the port of India nearest to Europe. The line from the Mediterranean to the Persian Gulf has been demonstrated to be eminently practicable and easy, which the other portions of the route between Constantinople and India are not. While capable of forming part of a through line, it would, at the same time, be complete in itself, and independent of any disturbances in Europe—the only portion, in fact, of a through line of railway which would be always, and under all circumstances, at the absolute control of this country. It would always be to this country the most important portion of any through line; and, indeed, I believe a through line could not be constructed, except at overwhelming cost, without the assistance of a port in northern Syria. It would, moreover, provide us with a complete alternative route to India, and would thus at once secure to this country advantages admitted to be of the highest national moment. It is for these reasons that, during the long period in which I have devoted myself to the advocacy of the Euphrates route to India, I have thought it expedient to urge upon our own Government and that of Turkey the special claims of that section only which would connect the Mediterranean with the Persian Gulf.

The objection that, although the Euphrates Valley Railway would afford us the undoubted advantage of an alternative, a shorter, and a more rapid means of communication with India, it would still leave a considerable portion of the journey to be accomplished by sea, and that, consequently, it would accelerate our communications with the East in a minor degree only, is sufficiently disposed of by the circumstance already pointed out—that a railway from a point on the Mediterranean, at or near Scanderoon, to the head of the Persian Gulf, would naturally form part of a through line of railway from Constantinople to India, if, at a future time, it should be considered necessary or desirable to construct the remaining sections.

At the same time, it is to be observed that any possible acceleration of the journey between Europe and India, by the substitution of railway for sea transit, would be, relatively, much less in the case of those portions of the route traversing Asia Minor on the one hand, and Persia and Beloochistan on the other, than on the central section between Scanderoon and the Persian Gulf; the latter section being almost level for nearly the whole distance, and, therefore, capable of being traversed at a very high rate of speed; whereas, both in Asia Minor and Persia, the gradients would be so severe as to neutralise, in a great measure, the advantages ordinarily attaching to railway travelling as compared with that by sea. *Pro rata* to the power required, so is the distance. In other words, the proposed Euphrates Valley Railway would take advantage of precisely that portion of the route between Constantinople and India where the greatest benefit would be derivable from the substitution of railway for sea transit, whether regard be had to the rate of speed attainable or the economy with which the traffic might be worked.

A regular mail service being already in operation on the maritime portions of the Euphrates route to India—maintained, on the Mediterranean side, by French steam packets calling at Alexandretta, and between the ports of the Persian Gulf and Kurrachee and Bombay by the vessels of the British India Steam Navigation Company—a railway of little more than 900 miles in length, from Scanderoon (or Alexandretta), on the Mediterranean, to Kowait (or Grain), on the Persian Gulf, is all that is required to secure for us the immense political and strategic advantage of a complete alternative route to India; a shorter and more rapid route than now exists, and one, moreover, which compares very favourably with the Red Sea route, both as regards climate and the facility and safety of the navigation.

Both Alexandretta and Kowait, the proposed termini of the railway, possess all the requisites of first-class harbours.

The harbour of Alexandretta is one of great capacity; sufficient, according to Sir John Franklin, Admiral Beaufort, and others, to contain the whole navy of Great Britain. It is the safest harbour on the coast of Syria, and might be made available for the purposes of the railway at a very small outlay. The place is, at present, open to some objection, on account of unhealthiness; but this, its only disadvantage, might be entirely obviated by drainage, at a moderate expenditure.

With regard to the harbour of Kowait, near the head of the Persian Gulf, Mr. William Parkes, who was, at my request, by the liberality of the Indian authorities, recently enabled to examine the ports in the Persian Gulf, states, in an able report addressed to me on the subject, that "nothing could be more secure or favourable in any way" (than Kowait) "for ships of the largest size, whether to ride at anchor, or to be moored alongside a quay wall." As a place for landing and embarking passengers, mails, and cargo, even without sea works more extensive than a short jetty to bring a steam tender alongside, Mr. Parkes reports that Kowait "was superior to Alexandria, to Suez, and to Bombay, before the completion of recent improvements; while, for an expenditure of from £80,000 to £100,000, a wharf of sufficient length to berth four steamers, of 3,000 tons each, might be constructed, and the railway brought down upon it, thus placing Kowait on a par, in this respect, with Suez as it is, Brindisi, or Dover." Kowait is already one of the most important towns in the Gulf, and, according to Captain A. D. Taylor, late of her Majesty's Indian Navy, possesses more baghalahs, or boats of the country, than any other port in the Gulf which trades with India; and there can be no doubt, if it be adopted as the eastern terminus of the railway, it will, within a very short period, have an enormous trade of its own, irrespective of the through traffic passing over the railway.

As regards the route which the railway should take between Alexandretta and the Persian Gulf, it is to be borne in mind that the great and primary object of the undertaking is the connection of the Mediterranean Sea and the Persian Gulf by railway; and, the necessity of such a connection having been once established, the precise line which the railway should take would appear to be comparatively a matter of less vital importance. I may observe, however, that, passing in the first place from Alexandretta, the proposed terminus on the Mediterranean, to Aleppo, a great *entrepôt* of

trade, the route from that place to the Persian Gulf having much the strongest arguments in its favour would appear to be that recommended by Captain Felix Jones, keeping on the right bank of the Euphrates for the whole distance, beyond the reach of inundations, and passing by way of Annah, Hit (the Is of Herodotus), the holy cities of Kerbela and Nedjef (or Meshed Ali), Semárwah, and Súk-esh-Sheyukh to Kowait or Grain, on the Persian Gulf. This line would not pass many miles from Bagdad. This city and the neighbouring holy places of Kerbela and Nedjef, are frequently chosen by Sheeah Mahommedans as a residence, that they may be buried by the side of Hoosein, their favourite saint, whose tomb at Kerbela is the peculiar object of their veneration, and is annually bedewed with the tears of thousands. The burial-place of Ali Nedjef, though of inferior sanctity, is also held in great veneration. Pensioners of the Government of India, natives of the highest rank, frequently make Bagdad or Kerbela their adopted home; and, both from Persia and Hindustan, untold wealth has been poured into the coffers of the priests of Kerbela.

The route which I have traced from Alexandretta to the Persian Gulf—besides being, probably, the shortest line obtainable—would obviate altogether the necessity and expense of crossing the Euphrates. This line, moreover, regarded from a strategic point of view, would give the advantage of the interposition of two great rivers between the railway and an enemy advancing on the flank on which there would be the greatest likelihood of attack. The two termini, being on the open sea, would be, virtually, under the guns of our ships, and the value of the island of Cyprus would be demonstrated as a *place d'armes*.

The opening up of the Euphrates route would afford an additional guarantee for the integrity of the Ottoman Empire; would tend, in a great measure, to a peaceful solution of the Eastern question; and would enable us more easily to discharge the grave responsibilities we have incurred in the virtual protectorate of Asia Minor. The proposed railway would consolidate the dominions of the Porte, by bringing the ancient Pachaliks of Aleppo and Bagdad into closer communication with the seat of Government. The grand impediment to the improvement of the Sultan's dominions is the want of means of intercommunication; and no line would promote more effectually their good government and prosperity, or do more to develop their really prodigious resources, than that which would lay open, to the energy and capital of the emigrant and merchant of the West, the extensive and fertile plains of the Euphrates and Tigris.

The cost of the most difficult portion of the railway, surveyed and estimated for by General Chesney and Sir John Macneill, and an engineering staff, was £7,500 per mile; my estimate has been higher, to make allowance for the fluctuations in the price of iron and other expenditure.

Let me recall for a moment to your notice the political inheritance said to be bequeathed by Peter the Great to his successors, in his will, whether genuine or apocryphal. "We must," says that remarkable document, which first became publicly known in 1837, "incessantly extend ourselves towards the north, the Baltic Sea, and towards the south, the Mediterranean. We must advance as much as possible towards Constantinople and India. Whoever shall reign there will be the true masters of the world. Therefore, we must face continual wars, sometimes with Persia; create dockyards and emporiums on the Black Sea; take possession, little by little, of that sea, as well as of the Baltic, which is a point doubly necessary for the success of the plan; hasten the downfall of Persia; advance into the Gulf of Persia, as far as can be done, re-establish through Syria the ancient commerce of the East, and enter into the two Indies, which are the stores of the world. When once there, we can do without the gold of England."

The policy of Russia has certainly been in accordance with the above.

The old southern boundary of Russia in Central Asia extended from the Ural, north of the Caspian, by Orenburg and Orsk, to the old Mongolian city of Semipolatinsk, and was guarded by a cordon of Cossack outposts. In 1716, Peter the Great sent a force, commanded by Prince Bekovitch, to take possession of part of the eastern shore of the Caspian. Three forts were then built, though subsequently abandoned, after an unsuccessful expedition against the Khivans. More recently, since 1834, Russia has succeeded in firmly establishing herself on the eastern shore of the Caspian, where she has now four permanent posts, Fort Alexandrovsk, Krasnovodsk, at the mouth of the Balkan Gulf, Chakishlar, at the mouth of the Attruck, and the Island of Ashurda. To the east she has crossed the Kirghis Steppe, and established herself on the Sir Daria or Jaxartes, which Admiral Boutakoff is said to have navigated for 1,000 miles in 1863. Thus the Russian frontier in Central Asia has been pushed forward, until her advanced posts on the east look down from the Tian Shan range upon the plains of Chinese Turkestan. In Western Turkestan, also, she has gradually extended her boundary, and has annexed or subjected Tashkend, Kokan Khojund, Samarcand, Bokhara, and Khiva. In thus pursuing her career of annexation, Russia but follows the natural policy of a great military empire; being forced, moreover, as Sir John Malcolm said, by an impelling power which civilisation cannot resist when in contact with barbarism. And thus is her influence established on the Oxus and Jaxartes. The Oxus, or Amu Daria, is a noble river, not easy of navigation, but, it is believed, capable of being made so. It will furnish a ready means of carrying the tide of Russian annexation eastward until it finds a barrier in the Hindoo Koosh. When Russia shall have established herself along the Oxus, her position will be at once menacing to Persia and India. From Chardjuy on the Oxus, there is a road to Merv, distant about 150 miles, and from Merv a direct road runs along the Valley of the Murghab to Herat, the so-called "key of India." Merv is, historically, a part of the Persian Empire, but, in these countries, it is notoriously difficult to define boundaries with any precision. Should Russia succeed in occupying Merv—as there is too much reason to fear that she ultimately will—and in converting the neighbouring tribes into friends or allies, her position would be one which would necessitate still greater vigilance on our part.

Surely in the face of such facts as these, the time has arrived when England should rouse her-

self from the apathy of the past, and take steps to secure the incalculable advantages which would accrue to herself and her Eastern dependencies from the opening up of the Euphrates route, which would threaten the flank and rear of any force advancing towards India.

The subject, important as it is in its bearing on the power and stability of the whole British Empire, is one of absolutely vital moment to India; but it should not be forgotten that all our Eastern possessions would participate in the benefits which would accrue from the establishment of the Euphrates route.

There is ample reason to believe that the proposed undertaking would prove remunerative at no distant date; at the same time, the results sought are far more important than those which are usually looked for in a pecuniary investment. Why should we not regard the Euphrates Railway as the French have regarded the Suez Canal? In the words of a recent writer:—

"Nations may receive much larger returns for judicious outlay than any to be commonly looked for by shareholders; for the results in material prosperity to be derived by a community from augmented facility of communication, from moral and political progress, and, above all, from an increased security for peace, far transcend in value any conceivable amount of dividends, and should be taken into account in determining as to the propriety of lending Governmental assistance in particular instances."

The general features of the projected Euphrates Valley Railway may be thus briefly summed up:—

1. It would connect the Mediterranean with the head of the Persian Gulf, between which and Kurrachee and Bombay regular communication is now maintained by a line of powerful steamers, subsidised by the Indian Government.

2. Making Kurrachee the European port of India in place of Bombay, it would save about 1,000 miles in the distance between England and India, and would reduce the time occupied in the journey by several days.

3. It would render it possible to maintain India with a smaller European garrison than is now necessary, and would thus reduce our military expenditure.

4. It would save the Government large sums, in sudden emergencies, by the facilities it would afford —and that at all seasons of the year—for the transport of troops and stores.

5. It would enable troops from England to be landed at Kurrachee in about 14 days, and in two or three days more at Lahore, Peshawur, or Delhi.

6. It would subject an enemy advancing towards the north-western frontier of India to easy attack in the flank and rear, and would render the invasion of India all but impossible.

7. It would render the resources of England so promptly available in the East that any hostile movement directed against us, whether from within or without our Indian frontier, might thus be effectually checked before it could assume formidable proportions.

8. It would give our extensive military establishments in India a direct influence in support of our power and prestige in Europe.

9. It would give England the first strategical position in the world.

10. It would facilitate the protection of Asia Minor by England.

11. It would relieve Persia from the predominating influence of Russia, by giving her access to a port on the Mediterranean.

12. It would be easily defensible by England, both of its termini being on the open sea.

13. It would be protected, on the flank most likely to be assailed, by two formidable rivers, the Euphrates and Tigris.

14. The length of the railway, from Alexandretta, on the Mediterranean, to Grain, on the Persian Gulf, would be about 920 miles.

15. The country is admirably adapted for the construction of a railway, and the cost of the line is estimated at from £8,000 to £10,000 per mile.

16. The capital which would be required would thus be under 10 millions.

The military and political value of the Euphrates line is a matter of extreme moment, and has a far more decided bearing on the defence, not only of Turkey, but of Persia, and the whole district lying between the Mediterranean, the Caspian, and the Indian Ocean, than might at first be supposed.

So long ago as 1858, Field-Marshal Lieutenant Baron Kuhn Von Kuhnenfeld, Austrian War Minister, predicted that Russia would, in future, probably, try to satisfy her craving for an open seaboard by operating through Asia:—

"She will not," says this distinguished authority, "reach the shores of the Persian Gulf in one stride, or by means of one great war; but, taking advantage of Continental complications, when the attention and energy of European States are engaged in contests more nearly concerning them, she will endeavour to reach the Persian Gulf step by step—by annexing separate districts of Armenia, by operating against Khiva and Bokhara, and by seizing Persian provinces. * * *

"The most important lines which Russia must keep in view for these great conquests are—

"1. The line from Kars to the Valley of the Euphrates and Mesopotamia.

"2. That from Erivan, by Lake Van to Mossul, in the Valley of the Tigris, to Mesopotamia, and thence, after junction with the first line, to Bagdad.

"3. That from Tabrez to Schuster, in the Valley of the Kercha, where it joins.

"4. The road leading from Teheran, by Ispahan, to Schuster, and thence to the Persian Gulf. * * *

"Once in possession of the Euphrates, the road to the Mediterranean, *viâ* Aleppo and Antioch, and to the conquest of Asia Minor and Syria, is but short.

"It is clear that all these lines are intersected by the line of the Euphrates, which, running in an oblique direction from the head of the gulf north of Antioch to the Persian Gulf, passes along the diagonal of a great quadrilateral, which has its two western corners on the Mediterranean, its two eastern on the Caspian and Persian Seas, and so takes all Russian lines of advance in flank.

"From this, it is evident that the secure possession of the Euphrates line is decisive, as regards the ownership of all land lying within the quadrilateral. It must, therefore, be the political and strategic task of Russia to get the Euphrates line into her hands, and that of her enemies to prevent her doing so at any cost.

"The great importance of a railway along this decisive line, which connects Antioch with the Persian Gulf, follows as a matter of course. It is the only means by which it would be possible to concentrate, at any moment, on the Euphrates, or in the northern portion of Mesopotamia, a force sufficiently strong to operate on the flanks of the Russian line of advance, and stop any forward movement. * * *

"It is true that, at first, the aggressive policy of Russia in the East will only threaten the kingdoms of Turkey and Persia; but, as neither one nor the other, nor both combined, would be strong enough, without assistance, to meet the danger successfully, England must do so; and it is certain that she must, sooner or later, become engaged in a fierce contest for supremacy with Russia.

"The Euphrates Valley Railway becomes, therefore, a factor of inestimable importance in the problem of this great contest. Even now, the construction of the line will counteract the Asiatic policy of Russia, for it will strengthen the influence of England in Central Asia, and weaken that of Russia.

"The growth of Russia in the East threatens, though indirectly, the whole of Europe, as well as the States named above; for, if she were firmly established in Asia Minor, the real apple of discord, Constantinople, would be in imminent danger, all the commerce of the Mediterranean would fall into her hands, and she would command the canal through the Isthmus of Suez.

"Whatever the commercial value of the Suez Canal to Central Europe, there is no doubt that it is secondary in importance to the Euphrates Railway, which affords the only means of stemming Russian advances in Central Asia, and which directly covers the Suez Canal."

Looked at in every light, historically, politically, and commercially, the proposed restoration of the ancient route of the Euphrates, throwing open the portals of the East to the commerce of the world, and to the arts, the sciences, and civilisation of the West, is an interesting and noble design, frought with consequences of the highest moment to the destinies of our race.

To plant industry and the arts where indolence and barbarism have hitherto prevailed—to hasten the day when the breath from the four winds, as foreshadowed by the prophet, will breathe upon the slain, and the dry bones will live; when "the wastes shall be builded, and the desolate land shall be tilled," and men shall say, "this land that was desolate is become like the Garden of Eden, and the waste, and desolate, and ruined cities are become fenced, and are inhabited." "So shall the waste cities be filled with flocks of men."

To accomplish this noble undertaking is the mission of England. Its fulfilment has already been too long delayed. Another nation, as Lord Beaconsfield, some years ago, took occasion to remind us, is slowly, but surely, extending her power eastwards, and is gradually establishing a footing in military positions, from which she can at once menace our empire in the East, and diminish our power and prestige among the nations of Europe; and I would close this paper by urging my conviction, that if we continue to neglect securing the establishment of the Euphrates route under the auspices of Great Britain, we shall speedily find that the shortest, easiest, and safest route to our eastern possessions has fallen into the hands of our most powerful rival for commercial and political ascendancy in the East.

DISCUSSION.

Sir Henry Tyler said there was a proverb in almost all languages, of which the French version was, *tout est possible à lui qui sait attendre*, but it must be taken with some qualification, for Mr. Andrew had given an extract from a speech which he made to Lord Palmerston 27 years ago, and the question was even then old; but still he thought the time was now come when it really had a chance of being seriously considered. There were a variety of political ideas on the subject; some politicians said the strength of the empire was from within, and that all without the British Isles was a weakness, but he hoped no one in that room would uphold such a gross fallacy. He asserted that the Empire of India was a source of enormous strength and wealth to this country, and that no more important measure for strengthening the empire generally could be devised than that of improving the communication between the 34 millions of Great Britain and the 220 millions of our subjects in India. There was no better way of accomplishing that end than by constructing this railway. He would not put it forward as a commercial enterprise, in a flattering prospectus, but he believed it was the interest of the Government to assist in the construction of it—and he would not put forward the scheme in any other way—and not only so, but it was the interest of of other European Governments to assist. It was not a mere national highway, but an international one; the Germans, the Austrians, the French, and our Indian Empire, might all fairly combine to secure the construction of this line, for they would all be benefited by it.

Sir Henry Drummond Wolff, K.C.B., M.P., said it was rather difficult for any member of Parliament to come forward to advocate a line of this kind without laying himself open to the imputation of being a Jingo; but throwing aside any fear of that kind, they must all have gathered from the paper that a line of some kind—and he believed the Euphrates Valley route was the best—was of the greatest possible importance to the future of this country. Disguise it how we might, there was no doubt that our great enemy was Russia; and though we might diplomatise and negotiate, and put off the evil day, sooner or later we should be hand to hand with Russia in the East. The policy of Europe at present had been to localise the great struggle between England and Russia in Asia. The Treaty of Berlin had turned out to be a coalition of the European States to prevent the aggression of Russia in Europe; on England had been thrown the onus of checking the progress of that gigantic power, and we must be prepared for the contingency. He believed we should hereafter have to contend with Russia, as we had, in the beginning of the century, to contend with the colossus of France. It would be England, very probably, without allies, who would have to struggle for existence with Russia in Asia. At the beginning of the century, we had military resources in Germany; Hessians, Hanoverians, and others, as allies; but, hereafter, we must look to Asia Minor for the military assistance which the resources of England did not supply. He believed the possession of Cyprus was valuable to us as commanding a position which would enable us, in a short time, to avail ourselves of those resources in case of need. He would not pursue that argument any further; but, feeling so strongly as he did that the time might come—though he hoped it might be long postponed—when we might be called upon to employ all our resources, both in England and abroad, against the aggression of a State whose ambition was insatiable, he hoped, when the time did come, there would be in existence a Euphrates Valley railway to enable England to obtain the assistance of the population of Asia Minor. If it ever were made, Mr. Andrew would certainly be looked upon as the Lesseps of the undertaking; they owed a debt of gratitude to him for keeping on through good report and evil report, and against every difficulty pressing it on the attention of the country.

Captain Cameron, R.N., though he agreed with Mr. Andrew in the desirability of connecting the Mediterranean with the Persian Gulf by a railway, differed with him as to the best route, and preferred the Tigris to the Euphrates Valley for many reasons. The really fertile country of Babylonia lay on the Tigris, whilst on the borders of the Euphrates, in many parts, it was im-

possible to raise a crop at all. This river might be a great water way, but owing to Midhat Pacha having destroyed some of the weirs, it was less navigable now than formerly. The old canals between the Tigris and the Euphrates were more or less strategic works rather than agricultural; and the opening of one of them in recent years by Midhat Pacha, had had the effect of ruining hundreds of miles of fertile ground. He saw around him on the walls, art, agriculture, manufacture, and commerce, but nothing about strategy, and therefore he would defer to another opportunity what he had to say on this point. It was true, by drawing a straight line across the desert, the line would be perfectly safe, but that was rather a cowardly position. He should prefer to having a salient angle which would cover the Suez Canal, and yet place you in a good position with regard to a possible enemy on the north-east. To take a railway from Scanderoon over the Beylan Pass would require an ascent of 2,000 feet in seven or eight miles, which would add enormously to the cost, both of construction and working. The Tigris route was in every way superior. He objected to any local name for the railway, and would like to have it called the Indo-European or Anglo-Indian; it should go to Bushire, and then along the coast of the Persian Gulf to Kurrachee. The first thing was to get from Tripoli, through Aleppo and the fertile country, which could easily be developed, to Bagdad. Herat was now in every Englishman's mind, and the fertile valley of the Hari-rud; why should it pass into hands unworthy to hold it? He believed we were more fit to have the dominion of subject races than any one else; and why should we let the garden of Central Asia, and all the commerce which would one day be developed there, pass out of our hands? Russia, with her protective duties—ruling straight lines on the map—would find her strategic railways of no value, but only sources of loss; whereas Englishmen, working forward with one sole object—commerce and honesty—would find their reward in prosperity and profit.

Mr. Hanbury, M.P., said there was another imputation besides Jingoism, to which members of Parliament might be exposed with regard to this subject, viz., that they did not show their interest in it in Parliament. But the fact was that, six or seven years ago, the House of Commons went very thoroughly into the matter, and a Blue-book was published, which was a perfect mine of information; and it only required public opinion to back up that report, in order to make the line a complete success. His experience in the country, however, rather led him to concur with Capt. Cameron, that the Tigris route was preferable to the Euphrates, and that Tripoli was a much better harbour than Scanderoon. At the former port you avoided the hill at the back, you had a gradual ascent into the interior, and there were no engineering difficulties whatever. This was an imperial question, and should be looked at in that light first of all; but still, both Englishmen and English Governments had to consider the question of £ s. d.; and it had often struck him that the American plan of making railways in undeveloped countries would be applicable here. When a line was made in America, the Government, who owned the land through which it passed, cut up the land for five or ten miles on each side into square blocks, like a chess board, and the Government took the black squares and gave the white to the company which made the line. Population soon flocked round the railway in countries like that; and such a gift of land to a railway in Turkey, for instance, would be a great inducement to the construction of a line. Then came the question of population. This line would have the great advantage of being on a level nearly the whole way; but the remarkable thing about Turkey was, that all these rich valleys, and the land which required very little labour to make it most productive, had hardly any population at all. All the people had taken to the hills, where alone they could defend themselves against the rapacity and exactions of the Government. He believed that if an English railroad were made there, with English protection and guarantee for order, the population would soon return from the hills, where they could only obtain a bare subsistence, and make this desert into a garden. Another question was that of irrigation in connection with these rivers. It struck him, when at Bagdad, and in the neighbourhood of Babylon, that the former fertility of that country was almost entirely due to irrigation; and it was a curious fact that the failure of irrigation was not due to the Turkish Government, but to Alexander the Great. In his time there were dams almost up to Bagdad, which afforded every opportunity for irrigating the country between the Euphrates and the Tigris; but Alexander, being anxious to build a great city south of Bagdad, destroyed those dams in order to make the Tigris navigable up to his intended city; from that day to this no further dams had been constructed, and the fertile country had, consequently, become a desert. No doubt one difficulty which would have to be met in constructing the railway would arise from the Bedouins, but he did not think it was a very formidable one. Col. Herbert, who was Consul-General at Bagdad when he was there, told him that if this railroad were made by the English, they would have a great advantage, in the fact that the Arabs had a greater respect for the English name than for any other; and these wild men, if treated fairly and straightforwardly, could be thoroughly depended upon. He heard an amusing instance of this. For a long time there used to be a camel post between Bagdad and Damascus, and these camels used to be often plundered; but at last, Col. Herbert made a kind of contract with the Arabs that he would not send more than two men with the letters if the Arabs would undertake not to plunder them. This was agreed to, and for several years the compact was observed; but at last it happened that an Indian official on his way home, thinking he would be respected, determined to travel with this camel post; he made the third man, and they had no sooner got into the desert than the Bedouins were at once down upon them, said the bargain had been broken, and stole the camels, the letters, and even the clothes of the travellers. The great purpose of this line would be to get rapid communication with India, but it would also aid England greatly in her protectorate of Asia, and it would be an immense service to the inhabitants of Turkey. A more honest, hard-working people than the peasantry of Turkey, whether Christian or Mohammedan, he had never seen; and nothing would more tend to promote civilisation, and give the people their just rights, than such a line of railway as Mr. Andrew suggested. He believed there would be plenty of commerce to make the local traffic pay, for he had seen large caravans of Manchester goods going across the desert. Taking all these things into consideration—the great imperial interest, the fact that the line would of itself be a paying concern, and the immense boon it would be to the inhabitants of those countries—he considered it was a project to which the most hearty support ought to be given.

Mr. Hyde Clarke said there was a divergence of opinion on one point, which induced him to call Mr. Andrew's attention particularly to one part of the policy which he now professed. It was quite true that, so far as the line of railway was concerned, he left that to be determined by scientific investigation, but if he were to carry out the line in any degree by the help of the Government of Turkey, he must provide in some degree for their interests. If they were to have land privileges, which would of themselves go far to pay the cost of the line, it was absolutely necessary to look to the wants of the Government of the country. If they looked to the present interests which were now engaging political attention—the interests of Central Europe—it was necessary that the Governments of Germany and

Austria, which feel equally with England the pressure of Russia, should have a through line from Constantinople, and be able to contribute on their part to the connection of that through line with this country. He was convinced that the delay in taking up this matter had largely arisen from talking of a Euphrates Valley line, the consequence of which was that the promoters were forced to depend solely on the English Government, which had not been willing to take it up, the co-operation of other Governments not being obtained. At one time the Austrian Government were disposed to take it up, but the favourable movement had been allowed to pass.

Mr. Scott Russell, F.R.S., said, seven years ago, it was his duty to examine professionally a line of railway which had the concurrence of most important persons in England, and in several other kingdoms, and of some of the Indian authorities, and he then received the assistance of distinguished Engineer officers in the English army, and in the Turkish army, and had placed at his disposal all the surveys which had been made by several of the great powers of Europe with reference to this subject. They went into Asia Minor, and had the largest portion of it carefully surveyed, and eventually arrived at certain conclusions; but as the whole negotiations were of a confidential nature, he did not feel quite at liberty, even now, to go into any details on the matter. He had long admired the energy of Mr. Andrew on this question, and should have been glad if he could have backed his recommendation by his own experience. He would, however, make a certain proposition which, if he would adopt, he was sure it would greatly assist his future endeavours, viz., to drop the term Euphrates Valley Railway, and adopt either the name Asia Minor Railway or Constantinople and Calcutta Railway, or London, Constantinople, and Indian Junction Railway, or something of that kind. If he would do that, he would advance his own views immensely, and get assistance, which, otherwise, he (Mr. Russell) felt sure he would lack. As an old naval man, a shipowner, and acquainted with ocean commerce to India, he might say that nothing was more impractical than the idea of sending a ship with a cargo for India to one of these charming ports which had mentioned, there unloading her, sending the goods by rail to another port, and then loading them into another ship for Kurrachee. The Suez Canal was open, and every merchant would prefer to send his goods by that route. The arguments in favour of the Euphrates Valley line which could be used before the English had obtained possession of a share of the Canal no longer applied. What was wanted, was through railway communication to India; and where was the Englishman who would not support it, so as to bring his children in that country within a five days' journey of home? Now, London to Vienna was a thousand miles, and you could go that distance very comfortably in a sleeping car; from Vienna you could now go as far as Belgrade, and very soon would be able to go to Constantinople in the same carriage which you took at Calais; and he would undertake that passengers should be delivered there in 48 hours from Cannon-street. There was a little bridge or a tunnel wanted at Constantinople, but it would not be very big; and it was, in fact, mainly with a view to arranging for that bridge, that he was originally sent for to Constantinople. As soon as things were settled, that would be made, but in the meantime it was a very nice and pleasant trip across by steamer. Then, from Constantinople to Mosul, there were no railway difficulties; and, arrived at Mosul, you had no difficulties but the difficulty of choice. He agreed that the Tigris was a far better line to follow than the Euphrates; from Mosul you could go to Bagdad, and then cross over through Persia, and so get into the neighbourhood of Kurrachee. The whole of this route had been carefully surveyed, and the railway could be made at only ordinary cost. A railway through Asia Minor from the Mediterranean to the Persian Gulf might be worth doing in connection with a great through railway, but, unless you have the latter, small patches of railway would never pay by themselves. A through railway would command the co-operation and assistance of all the civilised Governments of Europe, and double the value of our territory in India.

Mr. J. L. Haddan said when he considered that, in England alone, nearly £700,000,000 is invested in railways, a sum (estimated on house valuation principles) which represents the whole of the national annual revenue capitalised, it did seem strange that we had no railway statesmen, especially when locomotion is the essence of free trade, which does not want for political support. He would qualify this statement, however, with an exception in favour of the author of the paper, whose views were once for all expressed in 1857, when he headed quite an imperial deputation to Lord Palmerston on the subject of the Euphrates Valley Railway—views which time has singularly proved the correctness of, and which it would take a bold man to contest in the face of the numerous authorities who formed the deputation, and of the opinion of the Premier himself, who received it. He (Mr. Haddan) would merely say that the Euphrates Valley Railway meets the great military requirements of running towards, but not parallel to, the Persian frontier; while the two great rivers protect its flank. Mr. Andrew's views cannot be mistaken. This railway Colossus plants one leg on the Mediterranean, and the other on the Persian Gulf, and that is his platform. He utterly ignores all the endless claims advanced, as to superiority in detail of one route over another, most of which are merely founded on the weakness of railway construction, and not upon commercial considerations. Mr. Andrew, however, must feel disappointed at being so badly seconded by engineers. In England alone, the home of coal and iron and cheap engineering talent, £50,000,000 of railway capital pays no dividend. What chance has it in Mesopotamia? To draw a parallel with regard to the East is always dangerous, because the *status quo* is so opposite in every respect—instance, the truck system is illegal here, while no body of men can be kept together in such a sparsely populated district without they are paid in food, which is more current than money. Although such colossal works indubitably raise the price of money—which is, doubtless, a good thing for a deeply indebted country, who mean to pay some day—yet the cost of an ordinary railway is often increased one-half by the rise in price of labour, caused by the demand for such abnormal quantities of it. In addition, railways made by hand require about three times as much earth to be moved as when made by machinery, because the contents of the cuttings cannot be carried to the banks in the usual manner; moreover, owing to the want of navvy skill and tools, very shallow cuttings, and very deep banks, replace the conveniently balanced banks and cuttings of a machine-made railway. As Chairman of the Scinde Railway, Mr. Andrew could tell the meeting that most Indian railways have to be more or less reconstructed every few years, owing to the effect of the tropical rains upon the earthworks and bridges. He (Mr. Haddan) thought it a modest estimate to say that the abolition of such an unreliable and uncommercial element of construction offers a premium of at least £1,500 per mile to any railway which can dispense with them.

Mr. Andrew, in reply, said he entirely dissented from Captain Cameron as to the mode of connecting the Mediterranean and the Persian Gulf. The great object he had in view was the readiest and quickest way of getting from the Mediterranean to the Persian Gulf;

as for going to Bushire and Herat, and so on, he left these rather wild enterprises to his young friend entirely. The gallant officer had made a mistake as to the Euphrates being incapable of navigation, for it is now as navigable as it was when Chesney, more than 40 years ago, with calm heroism, took the soundings of the river, at the risk of his life, from the suspicion and fanaticism of the Arabs who accompanied him on the raft. One of the boats of the Euphrates and Tigris Steam Navigation Company ascended last May, from Feleugia, on the Euphrates, opposite Bagdad, to Balus, 43 miles from Aleppo, with 100 passengers and merchandise, without having met with any serious obstruction. It was a question of English interests in the first place, and the shortest and easiest route would be by the Euphrates. It was not a question of commerce, but where you made a railway commerce would follow. He desired to assist the noble peasantry of the Turkish Empire, to support the scheme of protecting Asia Minor, but to make a longer route, and encounter difficulties, to do these things he should certainly object to. The interests of the Turkish Government were considered to be identical with a through line, and many years ago the Turkish Ambassador, who was a friend of his, requested him to write a report regarding the connecting the head of the Persian Gulf to Belgrade, laying out the branches he thought most necessary. That had been published over and over again, and he should be happy to send a copy to Mr. Scott Russell. But this through line was too gigantic an enterprise for capitalists to take up. He had been in communication with many eminent capitalists on the Continent with regard to it, but they could not see their way. The present Turkish Ambassador, Musurus Pacha, was much impressed with the soundness of the views he had now advocated, and his correspondence was published in the Blue-book containing the report of the select committee, showing that he was authorised by his Government to arrange for its construction. He had also enjoyed the advantage of the friendship and advice of the late Mr. Thos. Brassey, and his advice was:—Do not undertake a railway from Constantinople to the head of the Persian Gulf, unless you have a port on the Mediterranean. These views he had advocated for many years; they were vindicated by the House of Commons, and embodied in their report, and there had been no subject which had been so thoroughly sifted. He should as soon think of abandoning his own name as that of the Euphrates Valley Railway; and as for the objections which had been brought forward, he had met them effectually over and over again, and was ready still to do so.

The Chairman said the hour was so late that he would only ask the meeting to pass a cordial vote of thanks to Mr. Andrew.

The resolution being carried,

Mr. Andrew, on his part, said he desired to thank Lord Strathnairn for having a second time honoured him by coming forward to take the chair when he laid his views on this subject before a public meeting.

CORRESPONDENCE.

NEW METALLIC COMPOUND.

Had I known that Dr. Cole's paper last Wednesday would be descriptive of "Spence's Patent Metal," I should certainly have attended the meeting. In November last, I made certain experiments with the metal, and I should have liked to have given the Society the particulars of the results I arrived at, in the discussion which followed the reading of the paper. I trust, however, that I may be allowed to do so now.

That there are many uses to which the metal can be put, there is no doubt; and it seems to have given satisfaction to both Mr. Livesey and to Dr. Cole in the work for which they have each used it; but I think they are in error in saying that it expands in setting.

It has a very limited range of temperature, at which it is in a liquid state, and consequently cools or chills quickly on the outside, when poured into a mould, and thus draws the still molten metal in the centre, towards the sides. The result is, that it is most difficult to obtain a sound casting of any thickness. The outside will be smooth and perfect, and will fill the mould well, and may thus lead to the supposition of its expansion. If the metal is thin, the casting will no doubt be generally sound, but if any thickness of metal is required, some special means of casting will have to be adopted, or there will, undoubtedly, be a cavity in the centre. Mr. Livesey seems to have got over the difficulty of its getting alight, which it does very easily while it is being melted; and if he has broken any of the pipe-joints he has made, it would be interesting to know the result of his examination.

I should not be disposed, with my present knowledge of the material, to endorse the opinion as to its elasticity. It has not the ductility of lead, and hence gives different results; but I should consider that the continuity of the pipes experimented with was maintained more by its hardness and unyielding properties than by its elasticity. I may say that the experiments I made were to determine the tensile strength of the metal, which proved to be about 600 lbs. per square inch of section.

I forward to you a piece of a casting which shows the manner in which the metal contracts in cooling.

W. Faija.

4, Great Queen-street, Westminster,
17th February, 1880.

I regret that I was not able to be present at the meeting on Wednesday last, to listen to the paper on "Spence's Metal," by Dr. Cole, and take part in the discussion which followed. I have, however, read both in the current number of your *Journal*, and I may be permitted to say that while the material in question is very easily manipulated, can be run into the finest moulds, takes readily very delicate impressions, a very high polish, &c., and is, so far, suited for works of art, it is also excessively brittle, a fact altogether ignored or overlooked in the paper and discussion, though one which unfits it for taking the place of bronze, or even of zinc, in that connection.

It is, however, specially with regard to its use in jointing socket-pipes, that I desire to speak of it; and having had my expectations raised in this direction, I am reluctantly compelled, in the interests of my professional brethren and anyone contemplating its use, to state that, contrary to Mr. Livesey's experience, I have, as yet, been unable to get a sound joint by its use.

We have tried a considerable number on 4-inch pipes at these works, about half of which were made under the immediate supervision of Mr. Spence's representative, and not one of them has stood the test, the major portion leaking under a pressure of from three inches to five inches of water. Robert Morton.

London Gaslight Company, Nine Elms, S.W.,
February 16th, 1880.

Posting Proofs.—It is proposed to present a petition to Parliament in favour of the adoption of the system advocated by Mr. A. Clifford Eskell in the *Journal* for April 18th, 1879 (vol. xxvii., p. 448), by which certificates of the receipt of posted letters should be stamped at the office where they were deposited. A copy of the petition is now lying in the rooms of the Society of Arts for the signature of such members as may desire to further the object aimed at.

MEETINGS OF THE SOCIETY

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

FEBRUARY 25.—"The Noxious Gases Bill." By E. K. MUSPRATT, F.C.S. The Right Hon. LYON PLAYFAIR, C.B., M.P., F.R.S., will preside.

MARCH 3.—"The History of Musical Pitch." By ALEXANDER J. ELLIS, F.R.S. Dr. POLE, F.R.S., will preside.

MARCH 10.—"Recent Advances in the Production of Lambeth Art Pottery." By JOHN SPARKES. Sir PHILIP CUNLIFFE OWEN, C.B., K.C.M.G., will preside.

MARCH 17.—"The Art of the Silversmith." By W. HERBERT SINGER.

APRIL 7.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A.

APRIL 14.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

FEBRUARY 24.—"Views of Colonization." By WILLIAM FORSTER, of New South Wales. Sir CHARLES NICHOLSON, Bart., will preside.

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MARCH 11.—"Balmain's Luminous Paint." By C. W. HEATON, F.C S. Professor H. C. ROSCOE, F.R.S., will preside.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S.

LECTURE IV.—FEBRUARY 23.

Special applications of vulcanised caoutchouc. Mechanical or engineering applications of the material. Surgical uses. India-rubber stamps, or stereotypes. Vulcanised caoutchouc in the dwelling-house, garden, the children's play-room, and the printing-office.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 23RD...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture IV.)

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. 1. Mr. Hore, "Recent Visit to the Lukuga outlet of Lake Tanganyika." 2. Dr. Emil Holub, "The Marutse-Mabunda Empire in South Central Africa."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Henry Faija, "Portland Cement."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Mr. Cornelius Walford, "The Position of Life and other Insurance Associations in Relation to their Local Medical Examiners. Is it satisfactory?"

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. G. Phillips Bevan, "Waves and Currents of Industrial Progress."

TUESDAY, FEB. 24TH.....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. William Forster, "Views of Colonisation."

Rivers Conservancy Association (at the HOUSE OF THE SOCIETY OF ARTS), 2½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture VII.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, S.W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. W. H. Delano, "The Use of Asphalte and Bitumen in Engineering."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Dr. Edward B. Tylor, "The Origin of the Plough and the Wheeled Carriage." 2. Rev. Lorimer Fison, "Fijian Burial Customs." Dr. F. Dally, "Exhibition of Ethnological Specimens from British Columbia."

Royal Colonial, "Pall-mall," 14, Regent-street, S.W., 8 p.m. Mr. A. Staveley Hill, "An Empire's Parliament."

WEDNESDAY, FEB. 25TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. E. K. Muspratt, "The Noxious Gases Bill."

Coffee Tavern Company (at the HOUSE OF THE SOCIETY OF ARTS), 4 p.m.

Geological, Burlington-house, W., 8 p.m. 1. Prof. T. McKenny Hughes, "The Geology of Anglesey." 2. Mr. E. S. Cobbold, "Notes on the Strata exposed in laying out the Oxford Sewage Farm at Sandford-on-Thames." 3. Mr. G. W. Shrubsole, "A Review and Description of the various Species of British Upper-Silurian Fenestellidæ."

Telegraph Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion on Mr. Augustus Eden's paper, "Morse Signalling by Magneto-Electric Currents." 2. Discussion on Mr. Charles H. Wilson's paper, "Compensating Induction in Parallel Wires." 3. Mr. Oliver Heaviside, "The Resistance of Galvanometers." 4. Mr. J. B. Stearns, "The Variation of Electro-static Capacity in Submarine Cables." 5. Mr. H. R. Kempe, "Testing by Received Currents."

Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Gulstonian Lecture.) Dr. Gowers, "Epilepsy." (Lecture III.)

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. Robert N. Cust, "Recent Explorations in Rome."

THURSDAY, FEB. 26TH...Nipon (Japan) Institute (at the HOUSE OF THE SOCIETY OF ARTS) 4½ p.m. Mr. C. Pfoundes, "Home Life in Japan."

Royal, Burlington-house, W., 8½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. F. Wedmore, "Living English Painters."

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. Walter J. Allen, "The Art Culture of the Stage."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture V.)

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

FRIDAY, FEB. 27TH...Girls' Public Day School Company (at the HOUSE OF THE SOCIETY OF ARTS), 3 p.m.

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. F. J. Bramwell, "Sequel to the *Thunderer* Gun Explosion."

Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Croonian Lectures.) Dr. Cayley, "Some Points in the Pathology and Treatment of Typhoid Fever." (Lecture I.)

Quekett Microscopical Club, University College, W.C., 8 p.m. 1. Dr. T. Spencer Cobbold, "Human and Canine *Filariæ*." 2. Dr Sylvester Marsh, jun., "Bleaching and Washing Microscopical Sections."

Clinical, 53, Berners-street, W., 8½ p.m.

SATURDAY, FEB. 27TH...Trade Guilds of Learning (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.

Physical, Science Schools, South Kensington, W., 3 p.m. 1. Mr. H. R. Ridout, "Some Effects of Oilvatory Motion in Fluids." 2. "The Determination of Chemical Affinity in Terms of Electro-motive Force," Part I., Dr. C. R. A. Wright; Part II., Dr. C. R. A. Wright and E. H. Rennie.

Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 8 p.m. Mr. Saintsbury, "Dryden and his Period." (Lecture I.)

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FRIDAY, FEBRUARY 27, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROGRESS OF COOKERY IN PUBLIC ELEMENTARY SCHOOLS IN 1878-9.

In the last annual Report of the Education Department, for 1878 9, twenty-seven of the reports of one hundred and thirty inspectors are printed. In these twenty-seven reports Cookery is mentioned in only nine. The following is a short abstract of the opinions expressed:—

J. R. BLAKISTON (Leicester).—"I have at last the satisfaction of reporting that instruction in cookery is now given with marked success to girls in most of the Leicester Schools."—P. 479.

J. J. BLANDFORD.—"The Derby School Board have fitted up a room for cookery." He suggests that the girls of other schools in the borough should be able to attend on paying a small fee.—P. 493.

F. F. CORNISH.—Practical lessons in cookery, started at Lever-bridge (Salford district):—"I have felt rather glad that it was no part of my official duty to apply the only applicable test to the subject. The difficulties involved in the personal equation seem to render anything like a standard impossible."—P. 544.

J. LOMAX (Stockport district).—"Practical cookery taught to elder girls in Board schools; "satisfactory results; in great measure due to Mrs. Leech, the stay and patroness of the school;" he gives cost of utensils; suggests encouragement by a liberal grant. —P. 632.

H. W. G. MARKHAM (Northallerton district).—"A school of practical cookery to be started at Marske;" teacher from South Kensington, who already teaches at Darlington and Middlesborough.—P. 645.

T. PRYCE (Lanelly).—"No attempt to teach cookery, which he deeply regrets; much ignorance among Welsh people."—P. 673.

C. P. ROUTLEDGE (East Kent District) notices cookery at Ramsgate; little space required for experiments. Some cookery in Sandwich Girls' Schools on the school-room fire. "The excessive waste in the labourer's kitchen is surely a crying evil, enough to arouse the sympathy and interference of the Education Department, as well as of voluntary agencies." —P. 687.

W. F. TREGARTHEN (Dorset and Hants).—"'Where girls can be kept until they are 12 or 13 years of age, I think something might be done in the way of teaching common cookery without interfering in any way with the ordinary instruction." Notices Lady Wolverton's experiments at Fontmell Magna, and her valuable criticisms; everything to be taught useful for home life; weight of everything; price of everything; relative merits of articles of consumption. Real teaching well supervised.—P. 707.

J. H. WYLIE (Rochdale, Lancashire), noticing Domestic Economy, says, "I hope the time will soon come when male inspectors will be rescued from the anomalous position in which they are placed, of being called upon to pronounce an opinion, to which attaches a very distinct money value, upon a subject about which all know they are unlikely to prove competent judges."—P. 765.

The report states (p. 431) that 16,293 schools were inspected, consisting of boys, girls, infants, and mixed schools, making 23,618 departments. Of this number of departments, it appears that payments for "practical cookery for girls" were made in respect of instruction given in only 178 departments (see p. 431). How many children were taught in these departments, and what was paid for the instruction, cannot be ascertained from the report.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fourth lecture of the Second Course of Cantor Lectures, "On the Manufacture of India-rubber and Gutta-percha," was delivered by THOMAS BOLAS, F.C.S., on Monday, 23rd inst. The Lecturer dealt chiefly with the special applications of vulcanised caoutchouc. The Lectures will be printed in the *Journal* during the summer recess.

FOREIGN AND COLONIAL SECTION.

Tuesday, February 24th, 1880; Sir CHARLES NICHOLSON, Bart., D.C.L., in the chair.

The paper read was—

VIEWS OF COLONISATION.

By William Forster,

Formerly of New South Wales.

In New South Wales, and in Australia generally, British colonisation has come into contact with peculiar circumstances, which, among other things, offer great attractions to scientific exploration and research. The land is admitted by geologists to be the very oldest on the face of the earth—to have been longest uncovered by the sea, or by diluvian agency. It originally formed part of a vast continent, or archipelago, spreading north and west towards New Guinea and Africa, and including probably New Guinea and many other neighbouring islands. Perhaps, at a later stage, the Australian continent appears to have consisted of a rim of not very elevated mountainous tracts, surrounding a large central lake or sea, which, by subsequent elevation or deposit, became gradually converted into a barren desert of sand and ironstone rock, of which a vast portion is not more than seventy feet above sea level. This desert greatly affects, and may almost be said to govern, the climate. A considerable portion of it is utterly devoid of

vegetation. Another very large portion, though varied by an occasional oasis, and intersected here and there by trifling elevations, and by wide and shallow watercourses or watery deposits, generally dry or saline, is, for the most part, sprinkled with a scanty vegetation, confined to a few forms, destitute of and unavailable for animal life. Following the laws which seem to establish a proportion between average elevation on the one hand and both temperature and hygrometric conditions on the other, the climate of Australia is subject to rapid and extreme changes from heat to cold, and from moisture to drought. The rainfall, reckoned by long periods, is greater than in the British Islands, and there are times when the broad levels of the interior are flooded for miles, leaving only insular points at long intervals—a tendency, which, by the way, constitutes one of the great engineering difficulties of the future. But dryness is the prevailing characteristic, especially of the interior, and there is every reason to believe that periods of drought and moisture recur in cycles, which may, some day, be capable of statistical record. Local alternations in these respects are also matter of common observation. As might be expected, the general supply of moisture fails, and the aridity of the climate increases, from the coast to the interior everywhere, subject, however, to local influences of drainage and elevation.

The highest Australian mountains and land generally occur along the south-eastern coast, either in or near the southern and northern borders of New South Wales, which occupies a territory considerably larger than France, of some 323,437 square miles in extent, between the 28th and 37th degrees of south latitude, and the 141st and 154th degrees of east longitude. In these mountains rise the largest and most peculiar of the Australian rivers, and, in ordinary seasons, wind their way across, through narrow channels, and with languid currents, to the sea on the other side; all the most important western rivers of New South Wales, and many of Queensland, being finally merged in one *embouchure* in Lake Alexandrina, and a considerable number being lost on their way, except during rare periods of flood, in the sandy wastes and salt marshes of the desert. From its comparatively mountainous formation, as well as its position and extent, which give greater variety to climate and natural features, New South Wales may be considered as among the most characteristic of the Australian colonies. Its possession of by far the best and of nearly all the good harbours, combine with its greater age as a colony, its central situation, and abundant coal deposits, to enhance its commercial importance.

Australia was quite unknown to the ancients, and, at the time of the discovery of America, its existence was not even conjectured. The occasional and temporary contact with its north-western coasts, of Malay migration and development, has left behind it but scanty evidence, and a scarcely perceptible impression. Australia has, accordingly, remained from its origin, to the comparatively recent period of its discovery by French navigators in 1555, in absolute isolation from the rest of the world.

All this antiquity and isolation are proved and exemplified by corresponding peculiarities in Australian organic life and remains. The vegetable and animal forms now prevailing, as well as their latest progenitors among extinct genera and species, exhibit only a remote affinity with contemporaneous forms of the same category, in comparison with the affinity of the former, and their family likeness, as it were, to the organic forms of past eras, long prior to the existence of man, according to not only the ordinary interpretation of sacred records, but to geological evidence and computation. A similar process of evolution and development to that which has been going on for ages in other parts of the earth seems also to have been going on for a still longer period in Australia, but under more restricted conditions, in a narrower sphere, and with more direct tendencies. Accordingly, Australian organic productions are either identical with, or lineal descendants of, those of the secondary and tertiary geological epochs. Some have, in all probability, been developed locally from inland waters. Many of the vegetable forms, including whole classes and families—as, for instance, the proteads, epacrids, casuarinæ, and numerous genera and species among myrtles and leguminous plants, are either exclusively Australian, or rarely represented elsewhere. The prevalence of myrtaceous and leguminous plants accounts for the well-known monotony of Australian scenery. In animal life, many genera and species of insects, fishes, reptiles, and amphibia, including the *ceratodus*, *echidna*, and *ornithorhyncus*, are exceptional and peculiar, as well as of birds, among others, the honey-suckers, kingfishers, lories, lyre-birds, and brush-turkeys. The lower animals are all marsupial, with certain exceptions which prove the rule, as the dog or dingo of Malay importation, the half-developed amphibia, the navigating and migratory rodents. The abundance of individuals and species, as compared with classes or families, is also characteristic. On the other hand, innumerable species and families elsewhere widely distributed are not found in Australia, and the absence of marine tertiary remains is very remarkable.

The Aborigines are equally peculiar, or so to speak, idiosyncratic. Their rude arts and manufactures, their language, their manners and customs, are all distinctly primitive, or self-developed. In a word, if any race can claim to be authochthonous, it is the Australian. Their boomerangs, their spear-throwing sticks, their nets, mats, and domestic utensils, are clearly their own, or, in some cases, common only to equally primitive races. Their architecture has not advanced beyond the rudest possible stage. Their canoes and mode of navigation by a slender pole, could only belong to a people which has not come from beyond the sea.

Into this palimpsest, or natural museum of antiquity, has intruded itself one of the most advanced, if not the most advanced, of modern civilisations. As might have been expected, the Aborigines are dying out, which is the case with many far superior races brought into contact with our own, and other European races, as, for instance, the North American Indians, the Maories, and Polynesians generally. But why must we waste tears over these extinctions? Why should these primitive races be expected to survive more than many kinds of wild plants and animals, if their places be required for superior or more generally beneficial uses? It

is obviously desirable for scientific—which means for the highest class of philanthropic—purposes, to accumulate whatever records we can of their national or generic existence. But to preserve, as an organic whole or nation, any inferior race, even one of superior tenacity, when the conflict for room arises, is plainly impossible. No doubt, we owe them certain duties of humanity and justice, whether as a nation or as individuals; and, as with most human duties, it may be feared that our duties, like those of other conquering or colonising nations under similar circumstances, have been imperfectly performed. But British colonial treatment of aboriginal races, upon the whole, especially of late years, may be very favourably compared with that of many other nations, particularly the Spaniards, and people of the United States. The aborigines of Australia appear quite as irreclaimable as many classes of wild animals and plants. They have not, therefore, been encouraging subjects for direct interference. In New South Wales, the Government have done for them little more than affording them a languid and desultory protection, but they have not been generally illtreated by individuals. Wrongs have been done, and acts of inhumanity perpetrated in solitary cases, but, as a rule, the stories of systematic wrong or inhumanity by the settlers have been falsehoods, or gross exaggerations, emanating from a class of persons who seem to claim for themselves a monopoly of justice and humane dealing towards aboriginal races.

A very important question it is, no doubt, by what sort of colonisation these aborigines have been or will be replaced. In New South Wales, and in Tasmania, a grand and noble experiment was tried—which had been before partially begun in America—the success of which was so far from problematical, that its beneficial results are traceable at this moment, and, therefore, its ultimate abandonment, though, perhaps, in the particular cases referred to, and under all the circumstances, inevitable—but especially the precipitate haste and want of forethought and deliberation with which this abandonment was effected—are greatly to be regretted. New South Wales, then including much of what is now Victoria and Queensland, was a large Pentonville, or penal reformatory, upon what may be truly termed a national scale and system. The idea was to make so much of the elements of crime and disorder as were either for the most part factitious, or aggravated into unnatural intensity, by the pressure of want and a crowded population or by conventional extravagances, available for the combined purposes of reclamation and colonisation. Upon this foundation were built the colonies of New South Wales and Tasmania, and, substantially, the other neighbouring colonies of Victoria and Queensland. For, although attempts have been made on their behalf, in a somewhat ungrateful and ungracious spirit, to disclaim the association and relationship, these two latter are mere offshoots and extensions, and, in a certain sense, colonies, of the older colonies. Their populations were at first identical, and are still, in this sense, analogous. The convict element has, in fact, contributed largely to the wealth, prosperity, and successful development of New South Wales. This stigmatised class, or their descendants, have not been among the worst colonists in any respect, and, for industrial, intellectual, and moral qualifications, may fairly challenge comparison with the average of the emigrants brought into competition with them, either before or after the emancipation of the colony.

The process of colonisation since has been, in great measure, desultory and unsystematic, but by no means, in many important respects, unsatisfactory. There has been a marvellous development of material interests and prosperity. Fortunes have been made with unexampled profusion and rapidity, and money accumulated in vast masses by private skill, enterprise, and perseverance, and, in many cases, by the mere accidental and almost unconscious uses of lucky chances or opportunities, or by the collateral effect of general increase in population, commerce, and market values. The fields for labour and capital are less crowded—there is, consequently, less competition, less rigid division of labour, and greater demand for general willingness or capacity to work—than in older countries. There is more encouragement there than here—and more certainty of, if not, in the end, better, remuneration—for youthful, desultory, or undetermined talent or enterprise, which is what, I take it, is generally meant by the common phrase, "a better opening." Every one of these colonies is a great workshop, insufficiently supplied with either capital or labour, where the occupations have been hurriedly and rudely assorted, and, consequently, where every new comer is not only welcome, but has a wide choice of various kinds of employment. Another consequence is, that even indolence, ignorance, or incapacity has a better chance, and that more allowance is made for it, in certain respects, because there is more room, as it were, less necessity for close packing, or exact distribution, and less difficulty in making provision for emergencies and contingencies. But, in the long run, these defects bear their penalties in the stronger light and severer scrutiny, which are finally brought to bear upon doubtful claims or pretensions in a small community. This is why, paradoxical as it may seem, idle and worthless people, or "ne'er-do-weels," in colonies, find it often easier to live than elsewhere, but more difficult to make their way beyond mere living, or, as it is called, to "get on in the world." This is why, too, good character, unless with special application to employment sought, or work required, is of comparatively little value, and why bad character is less of an obstacle to procuring employment, and to attaining a certain amount and species of local influence and respectability. Money, being more easily made, and, perhaps, not less easily lost, in the colonies, is necessarily of less account. Station, and even title of a certain class, and high public position, are also less valuable or cared for, because more easily accessible to all, even the least qualified, and sometimes even to be obtained by not the most creditable means. People in the colonies are accustomed to see persons of questionable character and antecedents possessed of wealth, and, again, to see the same class of persons, with or without wealth, and whether or not endowed with fitness or capacity, climb by accident or artifice into the highest public positions, and sometimes tumble out of them again as speedily as they rose.

It is remarkable that private enterprise and investment have, in these colonies, taken a direction analogous to what now appears a local tendency in England—namely, to pastoral rather than agricultural production. Numbers of British and Irish emigrants carry with them to New South Wales their ideas of farming, but very soon find them utterly unsuitable to colonial circumstances. Agriculture proper, or pure cultivation of the soil, is always puffed by the press and by sentimental orators, but, as a rule, it is a failure when exclusively attempted, because it is seldom profitable unless combined with other pursuits. The main obstacles to agricultural success are scarcity of labour, uncertainty of climate, but, above all, facility in obtaining land at easy prices, which brings a class of needy and struggling adventurers and small farmers into continual competition with the genuine settler and capitalist. The former class are compelled or choose to disregard considerations of profit—the latter are naturally disinclined to invest their money at a loss. Of course, in a country where minerals—and especially where the precious metals—abound, mining of all sorts attracts a considerable portion of the capital and enterprise. In wealth, numbers, and influence, the gold-diggers form an important class. But all, even gold-mining, enterprise is confined to a few areas that are daily becoming exhausted, and the amount of capital and labour engaged in this species of industry bears no comparison with what is permanently absorbed in pastoral pursuits, while experience has shown that so much of a gambling spirit or element enters into mining speculations that they offer no safe inducement for strictly commercial enterprise or investment, and are, rightly, available only for two classes, the absolutely poor or the very rich. The production and prices of wool and tallow govern the home trade, and regulate the prices of all other commodities in the local markets. Pastoral production offers the most substantial attraction to, and secures the highest average remuneration for, both labour and capital. In pastoral occupations, not only have more fortunes been made, and money accumulated, but in this field a larger number of persons have risen from insignificant beginnings to wealth and importance than in any other. In short, the chief business and purpose of Australian colonisation have been the production and rude manufacture of raw material, in such form, and to such extent, as to fit it for exportation and finer manipulation. And, so far, this colonisation has been eminently successful. Local manufactures, no doubt, have arisen in various forms, and have, in some cases, succeeded. But it is a striking fact that, notwithstanding the enormous disadvantages against which importers have to contend, most colonial manufacturers expect the irventures to be fostered and protected at the expense of consumers or of the public, and many of them cannot be contented unless by the imposition of virtually prohibitory duties.

But these evidences of material prosperity must not blind the unprejudiced observer to certain social and political, and apparently organic, defects, which may or may not be due to want of forethought and system, or to inevitable natural causes. It does not follow, because we have established workshops and manufactories, and opened a vast drainage for the surplus labour and capital—not to speak of the pauperism—of the United Kingdom, that we have rightly performed the functions of colonisation. The emigration to New South Wales, as to other colonies, has been desultory and unsystematic in the extreme. Capital has found its way spontaneously, but the demand for it still remains practically unlimited. Labour has been introduced from time to time at the public expense, sometimes with temporary regularity, but constantly subject to intervals of suspension and relaxation, from various causes. Moreover, this public emigration has been, so to speak, one-sided—all from one class; that is to say, of labourers, or mechanics, or absolute paupers, most of whom thus step suddenly, or in a very brief period, from political disfranchisement or disability into the full enjoyment of equal political rights and privileges. Under these circumstances, oddly enough, has arisen, among the very class originally benefited thereby, a strong local and popular sentiment against public immigration, which, at the same time, locally considered, is not without political justification, involving, as it does, public expenditure for the apparently exclusive benefit of one class, and in order to create or maintain competition against another. Strictly public immigation, or colonisation, should be integral, not partial, or of particular classes. Such was, once, the migration of the ancient Athenians, when they left their city to the Persians. Such was, often, the migration of the early Celtic or Germanic, and of many Eastern or nomadic nations. Such was, in some measure, the Portuguese migration to Brazil. And some idea of the sort seems to have been embodied in the early colonisation of British American States.

For these reasons, among others, it is, perhaps, not to be wondered at, that society in New South Wales exhibits a want of organic or national cohesion from a local point of view. Of British patriotism, or, at any rate, of attachment to the Imperial rule, and British connection, there is plenty and to spare, but the sentiment of local, or Australian patriotism, probably requires time to grow. At any rate, it is weak and diffusive—rather a sentiment than a principle of action among political classes—and only shows itself, with any sort of intensity, among the native-born, with whom, again, as is often the case with indefinite sentiment, it is apt to assume an extravagant form, yet, after all, paradoxical as it may seem, tends tather to be sectional than local, and rather sentimental than practical, in its effects upon the community in general. Wealthy Australians, as a class, are not fond of remaining in the colony. Hence the popular obloquy incurred by "absentees," and the constantly-recurring threat, in newspapers and political orations—more easy, however, in theory than practice—of making absenteeism the subject of special and penal taxation. But the same spirit of instability infects other classes, as of labourers, and even small capitalists. Among all there is a natural tendency towards the interior, in search of pastoral capabilities and higher wages. But labourers wander over all the adjacent colonies indifferently, and what is commonly called a "rush" towards a gold-field, or other local market, draws multitudes, who never return to their former *status*. Attempts have been made, factitiously to create or establish settlements of small settlers, or,

euphemistically, "a happy peasantry," in various places, but the success of these schemes has been glaringly incommensurate with the public pains and money expended upon them, and one result has been the production of a novel and numerous class of petty merchants or traders in land, who use the special advantages offered them by the laws merely as capital to start with, and who carry on a profitable business by selecting homesteads, and selling out, at prices which might, and ought to have, replenished the public treasury under the ordinary processes of disposal of public lands. Not that land is not abundantly and rapidly appropriated, and the country so far progressively settled and colonised, but that there is more constant change and succession of owners, and less permanent improvement and occupation, than in the old world, or even, it would seem, in in the United States. Again, there is a strange, but most decided reflux, or reactionary current, of population and settlement, by a species of gravitation, towards metropolitan centres. Not only is the population of the large towns wonderfully inordinate, but it is remarkable what symptoms of decay and abandonment are exhibited in their neighbourhood by what were once apparently flourishing farms and homesteads. In short, an Australian colony is, as yet, rather a colony of traders than of settlers, and although, by a false analogy, these wandering propensities have been designated as "nomadic," and parallels drawn with other pastoral communities, it is yet plain enough, as already remarked, that the early migrations of the truly nomadic and pastoral races were movements, not of individuals, or groups of individuals, but of wholes, or integral parts, and, therefore, of an entirely different character.

An impression seems widely to prevail that, because Great Britain, whether as a right or a favour, has conceded self-government to certain colonies, thereupon British responsibility in their local concerns entirely ceased. Self-government—or Home Rule—was a right which must have been conceded at some stage or other of the connection. Direct intervention has since become impossible. But the consequences of British connection and influence remain, and will remain for ever, and always have to be taken into account. Some of the results of responsible Government in New South Wales and neighbouring colonies have not been encouraging, nor do they warrant extravagant hopes for the future. Representative institutions after the British type are based upon one essential principle, and one only, namely, "The majority is always in the right;" which is, in fact, the democratic version of "The King can do no wrong." But Government and aristocracy existed long before representation, or, at any rate, before representation had any vital effect upon political action and progress. The principle or practice of appeal to popular majorities was introduced here under a powerful and theoretically absolute monarchy, and in a thoroughly aristocratic condition of society, as a check upon the power of both monarch and aristocracy, and has proved a most effective means of restraining and modifying their encroachments and abuses. British political history has been that of successive struggles between two predominant aristocratic factions, each of which has, in turn, bought the support of the majority and obtained power by a series of concessions, until, at last, there is very little left to concede. And, for a long time past, the constitutional majority, embodied in the House of Commons, not content with acting as a check, or court of final appeal in doubtful or extreme cases, has, consciously or unconsciously, taken the initiatory as well as final—in short, one may say the whole process and power of Government into its own hands, and governs, or attempts to govern, accordingly. The same course of events has occurred in other constitutional Governments, and notably in ancient Greece and Rome, in the case of *ephori*, tribunes of the people, and the like—and in France, with her first constituent Assembly—as well as, apparently, at this very moment, not only in France, but in other constitutional states of Europe. It remains yet to be proved whether institutions, founded on this principle of absolute government by majorities, admirably as it has answered, and whatever grand results it has produced under an aristocracy, will succeed, or operate to produce good or effective government, in a pure democracy. Now, all British self-governing colonies, but especially the Australian colonies, as having sprung from a later stage of growth, are the purest of democracies. Their population, as already remarked, mainly consists of but one class, many of whom have been for the first time in their lives invested with political rights and privileges. In such a community as New South Wales and its congeners, the popular will is but feebly, if at all, restrained or counteracted by old ties or associations, by habits of fear, or reverence, for customary or constituted authorities, by the opinion or moral police of civilisation, or even by the generally acknowledged principles of the constitution by which the people profess to be governed. The press in a democracy, generally speaking, is not so much a reflection as a mere echo of the popular voice for the time being. In colonies, therefore, of this type, while public opinion, as we see or feel it in Great Britain and Europe generally, scarcely exists at all or speaks with but feeble voice and vacillating authority, the democratic passions of the hour or the moment, when once aroused, operate with fierce intensity, and are practically irresistible. The principle of absolute right in the majority, however temporarily or irregularly, or even illegally or unconstitutionally, yet *de facto*, predominant, is, moreover, intensified in its effects by the narrow sphere and the simple machinery through which it acts. Examples of this tendency have occurred repeatedly in New South Wales—for instance, in the abolition of transportation, in the passing of the first Land Act, in the anti-Chinese agitation, and so forth. But the apparently chronic results are equally, if not more unsatisfactory. The progressive deterioration of the standard of public men and of public morality—of a great deal that is valuable in government or institutions, but is quite outside the everlastingly boasted symptoms of material progress, and the thousand-and-one opportunities of ministering to personal profit, aggrandisement, and vanity—is undeniable. It is useless to talk of honesty being the best policy in colonial politics. In this sphere, on the contrary, men of inferior reputation in commercial or social life have sometimes the best chances of success, and, obviously, have

the strongest temptation and inducement to succeed, inasmuch as political life offers them the most ready means of rehabilitation, and for this purpose, as for all purposes of purely personal or commercial advancement, political life is desired. The more or less injurious effects of this state of things upon government and institutions are easily enough conceivable, and could be illustrated from facts of various kinds.

These consequences are often charged, by some thinkers, to universal suffrage, so-called. But whoever considers that self-government was a statutory revolution, in the midst of an absolute equality of political conditions, must see that the lowest possible suffrage was only a corollary and inevitable consequence of self-government. Its early adoption was, in fact, scarcely a change from the existing order of things. But, in so far as it was a change, it was obviously a wise anticipation of what must have come. On the other hand, we have those who endeavour to console themselves by the suggestion that the bad social results are but a temporary effect of novelty and youthful inexperience—so to speak—and that, as the colonies mature, their practice will improve. But this hope is somewhat inconsistent with the fact that the mischief progressively increases, and that, with every successive phase of development, matters seem rather to grow worse instead of better.

To be sure, the *Times*, in an article which begins by telling us that "The Legislature of the Colony of Victoria . . . . . is at present awaiting the judgment of the constituencies upon a complication of momentous issues," goes on to console us somewhat inconsistently with the information that "In the mother country there is a conviction . . . . that colonial politics form only the least important part of the active development of the colonies." But is it possible to regard political as only a negative factor in national or social morality? Let us hope—as, indeed, I believe and know to be the fact—that superior morality and superior refinement do pervade the private life and society of the colonies in a very large degree. In Sydney, especially, the resemblance to English society, and its social superiority over that of Melbourne, with all its vaunted commercial and political superiority, are generally admitted by visitors. But it is impossible to doubt that political deterioration must, in the long run ensue from the influences which have been described.

The large and liberal provision made for public instruction in Australia, and especially in New South Wales, is deservedly matter of colonial pride and general commendation. But of what avail is it to inculcate moral precepts, and to offer superior education, as, at least, one incentive to youth, in order to stimulate their regard for truth and honesty and for pecuniary and moral obligations—not to speak of courtesy, refinement, and sobriety of conduct and demeanour—unless these are afterwards accepted as passports to advancement in life.

It looks too much like adopting the old satirical, miserly, maxim of *Rem, quocumque modo, rem*, to accept the generally assumed financial prosperity of the Australian colonies, and particularly of New South Wales, as any compensation for political and social defects. But colonial finance has its dark no less than its bright features, and of the former certain facts are patent, namely, that the indebtedness of all these colonies has been progressive since their emancipation from the control of Downing-street, and that it is large in proportion to their resources, and extravagant in proportion to their populations. Another awkward fact for those who see or desire a millennium in colonial self-government and emancipation is this, that colonial revenues all have been largely drawn from the proceeds and disposal of vast tracts of waste or Crown lands, to which none of the colonies, much less those of later date, had any special right, and which, by their exhaustion, have rendered the collection or creation of revenue from other sources more imperative, and at the same time more difficult, from the very facilities they afforded, and the loose financial habits they had engendered in the meantime. The mischievous influence of political action upon finance in New South Wales has been, and is, as apparent as upon other branches or interests of the body politic. Granted that a considerable portion of the public debt was incurred in, and a large amount of expenditure devoted to, the construction of railways, and other useful, important, and partially reproductive public works, of which the colony has good reason to be proud, as well as grateful for, to her engineers and other public servants, nevertheless, it is well known that the original purchases, however necessary and beneficial, of both the Sydney and Newcastle railways from private companies, were, transactions, which were effected mainly by political means, which involved vast public loss, saddled the Treasury with a large and most unnecessary debt, and tended to the personal profit or advantage of a number of political and commercial speculators. Nor will anyone venture to deny that contracts for railways, and other public works or services, are subject to be, and have occasionally been modified or manipulated by political influences, and that stations and platforms, as well as roads, bridges, and public buildings, are sometimes unnecessarily or extravagantly constructed, and virtual monopolies in many of these cases secured for private or local interests.

The eccentricities of Victorian politics seem to have a little opened people's eyes in England to a conception of what popular majorities are capable of, even though they be constitutionally "always in the right." But, for whatever disapproval or ridicule their politics excite, the colonists of Victoria will probably consider themselves fully compensated by the superior notoriety they have gained, and the greater attention paid them by the British press and her Majesty's Ministers. Nor, indeed, is the tendency of Victorian legislation on the two disputed questions of graduated taxation and protection quite so exceptional as it is represented to be by alarmed capitalists and owners of property, or by Conservative or Free-trade newspapers in the colonies or in Great Britain. The Victorian graduated taxation of large estates has its prototype in the British income-tax, which equally embodies the principle of elimination of large properties and high incomes, for purposes of taxation and expenditure, subject to the votes of a

large majority who contribute nothing to the amount raised. True, the motives which operate in the two cases differ widely. The Victorian tax is not "as the British income-tax is" a willing contribution by the rich minority to exigencies of State. But not the less are the elimination and exemption of certain classes in each case equally arbitrary, equally opposed to old constitutional principles of the regulation of taxation and expenditure by the votes of a majority of taxpayers. The income-tax will be found to be a dangerous precedent when the non-paying majority of working men and petty capitalists begin to feel and organise their undoubted power. In the matter of Protection, the people of Victoria have been only seized with a prevailing epidemic in a virulent form. The new Protection is a democratic feature. The democracies of the world, no matter what their forms of Government, are against Great Britain upon this question. In spite of Cobden's memory—in spite of contemptuous protests in the *Times*—in spite of eloquent appeals from the Cobden Club, Mr. Fawcett, and others—in spite of the proved and undeniable advantages and reasonableness of free trade—Europe, America, and most British colonies, prefer Protection, with all its disadvantages, or find compensation in equivalent advantages, real or imaginary. Nay, it is by no means certain that many of us may not live to see a resurrection of the dry bones of Protection in Great Britain itself, of which there are already threatenings in manufacturing and agricultural quarters. And in all these cases Protection is the policy—and may finly be called a conspiracy—of a majority of mechanics and other labourers, as well as of small traders and manufacturers—in other words, of the comparatively poor, against the assumed interests of the rich. Accordingly, the graduated taxation and Protective policy of Victoria go, naturally, hand in hand. But New South Wales is not so far behind her neighbours as she is often assumed to be in the democratic race. Many leading politicians, and even Ministers of the Crown, in New South Wales, have expressed their approval of Victorian policy in both respects. Victoria takes the lead, because, sooner than her neighbours, she came to the end of her revenue from waste lands. The Protective spirit permeates all these colonies. Their tariffs are all practically Protective; and whether or not avowedly so, they differ little in essential principles, or in practice, from the tariff of Victoria. In New South Wales, about whose free-trade proclivities there has been much misconception as well as idle boasting and exaggeration, the abolition of *ad valorem* duties did not necessarily imply freedom of trade in its widest sense, since the tariff has since remained encumbered by all the old protective items, which, imposed avowedly for purposes of revenue in an emergency, have not been removed, although the emergency has long since passed away, and a surplus revenue has been made apparent for many years. In fact, a strong Protectionist party exists, and has always existed, in New South Wales, by which, although seldom strong enough to affect directly the policy of the country, it is well known that all elections, and the formation of ministries, are indirectly affected in a very important degree. Nor can any ministry, generally, be formed without including several professed Protectionists. Protection has been checked or prevented in this colony by its large public landed estate and extensive territory, which have created conflicting interests in commercial or political centres distant from Sydney. To crown all, a gold medal has been awarded by the Cobden Club to the mover of the following resolution, namely, "That a revision of the entire taxation of the colony is necessary, and that, in any such revision, revenue should be raised by the imposition of duties that would tend to foster manufacturing industry." (Votes and Proceedings of the Legislative Assembly of New South Wales, May 22, 1860).

Colonial destinies seem, at this moment, to have reached, or to be rapidly approaching, a point when it will be necessary to choose between two different and widely-diverging roads. These roads are indicated and exemplified by two different schools. I trust they may not prove two stools, between which the colonies run a risk of falling. The one is, in a manner, led and represented by Mr. Goldwin Smith, who preaches what may be called the doctrine of disintegration, that is to say, the disruption, by a gradual and amicable process, of the British Empire—or, at any rate, of the British Colonial Empire—and its subsequent distribution, into a number of new nations, or nationalities, analogous in type, and similar, if not identical, in race, language, manners, and institutions—or, to adopt the euphuisms of some members of the school, so many New Americas, or Greater Britains. Mr. Goldwin Smith's views have been repeatedly set forth with great eloquence and ability, and his arguments, if not unanswerable, cannot be said to have been satisfactorily answered. The contrary school, or doctrine, which is rather instinctive than consciously designed, purports to regard the aim and destiny of British colonisation to consist in extending, assimilating, and consolidating the British Empire and nation into a larger but still homogeneous and harmonious whole, capable of constantly impressing itself upon other nations and upon the world, as it has done hitherto, in proportion to its increase in strength, population, and resources. Now, which of these doctrines is the more reasonable, more consistent with facts, or more likely to be beneficial in tendency or operation?

The creation of new empires or nations has been, from time to time, the dream of imaginative individuals or enthusiastic bodies of individuals, but no new empire or nation has been ever thus factitiously brought into existence. We all know that nations spring and grow spontaneously, especially in their early stages. It may be added, in passing, that no effete or perished race or nationality has ever been resuscitated, the apparent instances to the contrary being all capable of explanation by the introduction of new elements, or infusion of new blood. Nor, so far as I am aware, has any nation, ancient or modern, whether by colonisation or any other method consciously undertaken the duty or process of reproduction. But a still more important fact is that, whether or not intended, this reproduction of a nation in its progeny, or in other nations directly descended from itself, has never taken place. There is no instance in early history—well authenticated,

and removed from the region of conjecture—of any colony having grown or become developed into a nation, if by this be meant an independent community, capable of surviving and perpetuating in a permanent form the parent race or nationality. It is very doubtful whether Carthage was, in any strict sense of the word, a Syrian or Phœnician colony, any more than the Asiatic and Egyptian empires which succeeded those of Alexander were Greek or Macedonian colonies, or than Rome was a Trojan or a Greek colony. The Greek and Roman colonies certainly exhibited considerable vitality, but they manifestly had no nationality or organic cohesion of their own, or apart from the nations to which they belonged, and were incapable of independent national existence or survival. Greece gave language, literature, and manners to the ancient world, but she left behind her as inheritors only the aforesaid Alexandrian empires or kingdoms, consisting as they did merely of local and aboriginal stocks, upon which had been grafted a foreign conquering class or military aristocracy. The Roman colonies were mainly corporations, which, greatly for the benefit of succeeding conquerors, infused their municipal spirit into the subsequent nationalities by which they were absorbed. Of modern colonies, the Spanish and Portuguese—which, besides British, are the only ones which have shown signs of independent vitality—can even now scarcely hold their own without foreign assistance against degeneracy into barbarism. Long ago, Miss Martineau pronounced an opinion to the effect that colonies, so far from bearing any proper analogy to new stocks or transplantations, are only offshoots, destined to perish with their parents. It will be said, however, that British colonies are instances to the contrary, and that, already, in the United States, we have a nation. This rather begs the question. Centuries of independent duration, of cohesion, of organisation are required to establish the fact of nationality. It is not every multitude of human beings, even of the same or of cognate races, associated or organised for a common specific purpose—for instance, an irruption of hostile barbarians, an army of crusaders, a band of robbers or buccaneers, or an assemblage of gold-diggers—that constitutes a nation. The principal business, the chief attraction, the predominant idea of the Anglo-Saxon or Anglo-Celtic masses who throng to and take possession of America and the Colonies, is the occupation and conversion of enormous tracts of waste lands to purposes of commerce and profitable investment. Until these lands are fully occupied and absorbed by a dense population, it is idle to speculate upon their future political destinies or nationality. Nor is it easy to conceive or believe in a nationality founded upon the principle of secession or disruption from an original national stock. And even this principle, which is, in fact, the charter and foundation of American independence and nationality—so-called—has been, as it were cancelled and stamped out, in blood and violence, by the late war. It remains yet to be seen whether the right or principle of secession, by virtue of which the United States became what they are, has been, or can be, altogether obliterated from the hearts and consciences of men by the superior force and military success of a majority of the same people, dominant for the time being. And as there is nothing in the end stronger or more inexorable than principles, and as this principle of secession, besides being the foundation of American independence and quasi-nationality, is in fact only a corollary from those principles of popular Government which are embodied in the American Union, and which were originally derived from British theory and practice, the probability is that the principle in question still survives, and that it will one day, in some fashion or other, make itself felt—if it be not already felt—in American politics, so as seriously to affect, perhaps even to endanger, the stability and permanence of national organisation.

At any rate, it must be obvious to students of history, that it was under quite different circumstances, and not by the use of such abundant means and resources, as modern colonies have at their disposal, that the great nations of the world at any time rose to power and importance. These nations sprang and grew from the seed or germ, as it were, of very small and insignificant beginnings. Their nationalities were created by prolonged or successive struggles, not of individuals, but of entire communities, as such, with wars and other adverse circumstances, by which at times their very existence as nations was threatened and imperilled. In such struggles, in fact, many incipient nations have been annihilated or absorbed into others more powerful or persistent. Those which survived have created for themselves language, manners, arts, and institutions. Colonies, on the contrary, are in some respects born full-grown, or are coddled into factitious maturity, amid all manner of concomitant advantages, under the fostering shade of, and in organic connection with, powerful and prosperous nations, of whose power and prosperity they partake, and form a part. The language, manners, arts, and literature of colonies are plainly not original, but derivative and imitative, or, in other words, found and created for them. In a word, the growth of nations is generally exogenous, while that of colonies is endogenous. But of all strained analogies, can any be more violent or inconsistent with facts than when national infancy or youth is attributed to colonies? Colonies are essentially wanting in the characteristics of immature life. Considered as communities, or as organic wholes, apart from the national centres to which they belong, and the races from which they spring, they want unconsciousness, spontaneousness, individuality, adaptability. They branch from the roots, as it were, like off-shoots, instead of growing upright into solid stems or trunks. The early mania for local separation, exhibited in the cases of Victoria and Queensland, of which their colonists seem so unaccountably vain, simply proved the want of organic cohesion and local nationality, such as has been often remarked in declining nations. Such cohesion as these colonies have, even in themselves, is neither organic nor national, but such as is possible in any association of workers or traders, held together by ties of common purposes or interests.

But, on the other hand, it is certainly most consistent with the early history of British colonisation to regard its purpose as not the foundation of new Empires or nations, but the extension and con-

solidation of our own empire. Nothing was further from the British mind, originally, than the creation of a new nation in America. And there can be no doubt that the rebellious colonies could, and would have been, reconquered, but that such a course was forbidden by British principles of representative Government, or, in other words, by moral as well as political obligations. Self-preservation is the law, not only of individuals, but of nations, and national increase and aggrandizement are but elements, or consequences, of national growth. Conquest precedes colonisation, which is the milder phase, or younger sister of conquest. Accordingly, it is not wonderful that the theory of colonisation, ostensibly accepted by public opinion here, is that most consistent with Imperial unity and consolidation, and that, as a rule, the leaders of parties profess a desire still to retain the colonies as parts of the Empire, however logical and philosophical may be the doctrines of disintegration preached by Mr. Goldwin Smith and his school. And since the war of American independence, a wonderful re-action, not uncommon in politics, has taken place in the colonial mind upon the question of colonial relations with the mother country. The colonists now everywhere profess so extravagant a loyalty as at times even to excite ridicule in England. Nothing seems so abhorrent to colonial feelings as the idea of separation from their Imperial centre. In New South Wales, a law was actually passed which it was dangerous, and was considered infamous, to oppose, making it penal to refuse to drink the Queen's health. But the very extravagance of this colonial sentiment renders it suspicious, as further appears when it comes to be tested by pecuniary and financial considerations, as in the cases of the Cape, Victoria, Canada, and elsewhere. And there is reason to fear that on both sides these professions of political attachment, judged by results, are more sentimental than practical. The best refutation, one would think, of Mr. Goldwin Smith's teaching, would be the embodiment in practice of contrary doctrines. But really a professed regard for the integrity of our colonial empire is not easily reconcilable with the zeal and pains exercised by successive British administrations, in urging and forcing, so far as Imperial influence has been available, systems of local federation, cut and dried in the mother country, thousands of miles from the places where they were meant to operate, upon particular groups of colonies, as appears to have been successfully accomplished in Canada, and as has been prospectively legalised at the Cape, and preached as gospel in Australia. It may be said that, among other advantages, this gospel of colonial federation is calculated to correct and counteract the separative tendencies, and want of local cohesion, above adverted to. But the futility of constitution-mongering need not here be insisted on. Federation has always proved but a poor substitute for nationality. Indeed, it is a sort of confession of the want of nationality. In an Empire such as the British, the true federalism is Imperial unity, and the factitious creation of new local groups, or centres of attraction, if successful, must be centrifugal in its effect, since it increases the centripetal impulse in a contrary direction, and weakens it accordingly in the direction of the common centre. There can, of course, be no objection to the growth and formation of colonial federations, by spontaneous local action, or from natural causes. But in so far as these federations, such, for instance, as the Canadian Dominion, are brought into existence by Imperial or official influences, they are obviously factitious, while in so far as they are not factitious, or are even nominally spontaneous, it were surely wiser and more consistent with Imperial functions and interests to leave them to the colonies themselves. The results of British interference have not been encouraging. From at least one federal State of the Dominion has already emanated a significant protest, and cry for release from the federal bond, on the ground of breach of faith, in short, for a species of wrong for which there is properly no remedy, upon the principle of absolute right in the majority. And if the wrong exist, it is aggravated and perpetuated by Imperial authority, for otherwise it is not likely that the seceding State could be annexed by the Dominion. But the worst result of colonial federation, as seen in Canada and elsewhere, has been an increase and consolidation of the same protective spirit and policy that are exhibited severally in other colonies, and consequent exclusion of British commodities from local markets on a still larger scale. At the Cape, the colonists suspect in federation a snake in the grass, or, in other words, an instrument of local taxation and compulsory contribution to war expenses, and so refuse to listen to the voice of the charmer. To all appearance, a general protective policy would follow South African federation. And federation is all that is wanted to bring about a similar result in the Australian colonies.

It is scarcely necessary to remind an English audience that finance is, and has been, one of the most important elements in political questions, and the principal agent in some of the greatest political revolutions. So was it, not to mention others, in the case of Magna Charta, of Hampden, and of the first and greatest French revolution. The disputes now going on at the Cape, and which are similar to what have occurred in other colonies, from time to time, upon questions of expenditure, and the payment and control of Imperial troops, might furnish Imperial statesmen with some clue towards the solution of this grand problem of Imperial federation—that is to say, of federation of all the self-governing colonies, and of Great Britain and Ireland in one great Empire and representative system—a question which differs widely from that of local federation, and is of far greater interest and importance, even to the colonies, than any local question. It may be quite reasonable for the Imperial Government to expect, and even demand, that every colony shall contribute to the expenses of wars, or of other matters, by which it has been generally or specially benefited. But it is equally reasonable for the colonies to object to contribute to the expense of wars, and other foreign transactions, over which they have no control. The one may be a question of justice, or moral obligation, the other is a question of constitutional right and practice. As component parts of a representative system of Government, the colonies are entitled to a voice, proportionate to the population and importance of each, in the regulation of any expenditure in which they are called upon to share. And this

voice, this regulating power, can only be effectively provided for by representation in the Imperial Parliament, or in some equivalent or superior assembly, clothed with supreme authority over Imperial and federal, or properly national, affairs. Such authority, doubtless, is now technically and legally vested in the Imperial Parliament, but constitutionally, and *de facto*, this parliamentary authority has in great measure become nominal, by the grant of self-government to certain colonies. The only means of restoring vitality and validity to this nominal authority, is by including the colonies among its constituent powers. The colonies have the Home rule, which Ireland is clamouring to have. What they want is that participation in Imperial rule which Ireland has, but on which she seems to set small value. By conceding self-government, Great Britain has, in fact, admitted the political and federal equality of the colonies. If the colonies be integral parts of the Empire, this concession will have to be extended to its logical consequences, by further concession and recognition of, and by making provision for, proportionate rights in the federal Government of the Empire. It really seems as if the question were between extension and consolidation of the Empire on the one hand, and disintegration on the other.

Surely it is open to anyone to augur a more brilliant and prosperous future for the Australian colonies, as permanent members of a great world-wide, world-ruling, federation, than as fragments of a shattered or dissolving empire, drifting into infinite space. Surely, assimilation and association with British political rights, interests, and tendencies are preferable to vague divergence into American types. It is argued by Mr. Goldwin Smith that all reciprocal advantages can be secured to Great Britain and the colonies without political connection. This may be true, in the case of the colonies, so far as merely material interests generally, or the particular interests of individuals, are concerned, provided the peaceful relations of the colonies with the rest of the world, or among themselves, remained undisturbed. But few can fail to perceive the beneficial influence of British connection, not only in maintaining peace, but in neutralising the evil effects of war anywhere. And will any amount of material prosperity or individual success compensate for loss of British nationality, or for national deterioration, threatened or exemplified as it appears to be by the progressive predominance of inferior or unsuitable men in public affairs, which, whether from political or whatever causes, already casts so black and ominous a shadow over American destinies, and begins, as it were, to darken the air in so many self-governing British colonies? For this fatal tendency the most effective, if not the only remedy is surely to be found, not in the disruption, but in the extension and enlargement of political associations throughout the Empire, and in the interchange of political sentiment and action from remote points of a large and almost infinite area.

Nor would the advantages of Imperial extension and consolidation by means of a more complete and effective system of federation be entirely confined to the colonies. Great Britain has already benefited, in more ways than one, by the political influence of the colonies. It is a notable fact that some of her leading statesmen have been trained in colonial schools, and the benefits thus conferred strengthen the Imperial body politic, because they are organic and national. Whereas, all American influences, even when beneficial, as they sometimes are, are disruptive and anti-national, because they flow from beneath only, and not through legitimate political channels. Mr. Goldwin Smith sneers or laughs at British prestige. Let it be granted that his ridicule is deserved, and prestige but a sentimental dream. Nevertheless, size or extent of territory, peopled by a homogenous and politically united race, is an obvious element of national greatness, which was never despised by the born conquerors or legislators of past times, and which must become of more and more importance while modern civilisation continues or developes in its present form and direction. But the popular feeling and attitude of the United States towards Great Britain, especially in times of difficulty or emergency—that of the South American or Spanish colonies towards each other—the jealousies of British colonies, and what we justly termed their hostile tariffs against Great Britain and their neighbours—confirm all the lessons of history to this effect, namely, that the political or national severance of kindred and neighbouring races or communities has been almost invariably accompanied or followed by mutual jealousy and hostility, sometimes in an aggravated form. Accordingly, both for the sake of Great Britain and her colonies—whether to maintain the peace of the world by means of a powerful and predominant nationality, capable of giving the law to other races and nations—or to prevent the waste of Anglo-Saxon, or Anglo-Celtic, blood energies and resources in domestic feuds—the most important work of British colonisation seems to me to consist in the permanent establishment and systematic development of British Imperial federation, by drawing closer than ever, by every means in our power, the political ties between Great Britain and her colonies.

DISCUSSION.

Sir Robert Torrens, K.C.M.G., was grateful to Mr. Forster for his paper, but hardly thought it bore out the title given to it, since it did not describe any system on which colonisation ought to be carried on, but rather described the effects produced in one particular colony, where no special system had been adopted, but the country had simply been used as a receptacle for the moral sewage of the British Empire. After summarising what he understood to be the evil results described by Mr. Forster, as existing in New South Wales, Sir Robert Torrens said he could point to a very different state of things in a neighbouring colony, which had been established on different principles. Some 45 years ago, he remembered a meeting, in a room not far from this, to advocate the founding of a colony on the principle advocated by Edward Gibbon Wakefield, a name which ought to be held in honour in every country. The first principle he laid down was, that the waste lands in the colonies ought to be held in trust for the people of England, and disposed of for their benefit; the next, that they should be sold at a reasonable, uniform, upset price, and the proceeds employed in bringing over English, Irish, and Scotch labourers, to cultivate the land so sold; thirdly, that the population should not be too much scattered, and that the surveys should not be extended too far until the land first taken up was fairly occupied. The vital principle of the whole was that the

object should be to establish a yeomanry in the country, who should be owners of the land they tilled. He had lived for 24 years in the colony established on this principle—South Australia—and saw the first crop of wheat which was reaped there, and therefore his testimony might be of some value. The land was sold in lots of various sizes, from eighty acres up to a square mile, at about £1 an acre, and the colony prospered immensely. The first Governor was not very well fitted for his post, being too amiable, unwilling to believe any evil of anyone, and without any knowledge of the elements of political economy, and, as a consequence, some of the first emigrants sent out were employed on Government works unnecessarily, instead of going to work on the land. But when Sir George Grey succeeded him, a change soon took place, and in twelve months, instead of importing hay, &c., from the older colonies, they exported it into Tasmania, New South Wales, and Victoria. There was none of the demoralisation there of which they had heard; in fact, there was not a more moral people on the face of the earth, simply because they had no temptation to be otherwise. Everyone had a prospect in a few years of becoming independent and owning his own farm, and several of those he took out with him from Ireland, who could not even speak English, before he left the colony owned 15,000 or 20,000 acres of land. Crime was almost unknown; there was no such a thing as theft, and not more than one murder in twenty years. No one thought of having a lock on their doors, until the people came flocking in from the convict colonies, and that they put a stop to by fining the captain who brought them £2 for each man, and shipping them back again. This was, perhaps, unconstitutional, but as fast as her Majesty disallowed one law of that kind, they passed another. This excellent Wakefield system was carried on until the time of the gold discoveries; soon after that the home Government took up the idea of granting responsible Government to these colonies, for which they were quite unfit, and bribed them to accept it by an offer of all the land in the colony. The temptation was too great to be resisted, and so these lands were alienated for ever from the people of England. Manhood suffrage was adopted at the same time, which he opposed, because he knew the people were not fit for it, having hardly any knowledge of the history of their own time, and none at all of past-times, but it was no use. The result was that of those who obtained this privilege, most had come out at the public expense, and the first thing they did was to kick down the bridge which they had crossed over, from poverty and misery in England, to independence and comfort in Australia. They repealed that system, and said the Government had no more right to import labour into the colony to compete with themselves, than it had to import merchandise free to compete with traders. They adopted payment of members, and so politics became a trade, and some of the most unfit persons became members of the Legislature. It had been said that South Australia rose because of the mineral discoveries, but he disputed that altogether, and he was treasurer of the colony at the time. He was confident that it would have been better, both for the colony and for England, if the gold had never been discovered, and they had stuck to the Wakefield system. In all the Australian colonies, except South Australia, protection had been adopted. They knew they could not compete with England, but, nevertheless, they sought to exclude her manufactures, and foster their own; the plain English of which was that the whole population were to be diverted from the pursuits which the nature of the country rendered most profitable, and their labour applied in directions in which it was much less productive. In new countries, the proper function of labour was to cultivate natural products, and so produce food and new material for the mother country. South Australia was now supplying this country largely with wheat, and her population consumed £8 per head of English imports. There were no protective duties; only a 5 per cent. import duty for purposes of revenue. Their object was to raise taxes with the smallest expense in collecting, and at the period when it was most convenient for the parties from whom it was collected to pay; that was the great principle laid down by Adam Smith. This 5 per cent. could not be a protective duty, because there were no manufacturers to protect, and with the rate of interest at 10 per cent., and wages 6s. a day, it was impossible to establish them profitably. They sent wool over to England, and brought it back converted into cloth. There was a heavy duty on tobacco and spirits, which yielded a large revenue, but there was no distilleries. On pianos, plate, and some other luxuries, there was a heavy duty, but that was not protective, because there were no piano manufactories there. He believed the only possible resuscitation of a right state of things in these colonies would be a closer amalgamation with the mother country. They had the highest authority for the doctrine in Adam Smith, who laid down that the use of colonies was to aid the mother country in maintaining the external defence of the whole of the Empire, and that the resources of all parts of the Empire should be employed to defend any part which might be attacked. Only a fortnight ago a vessel came into London with a cargo of meat from Australia; he dined on board of her, and better meat he never wished to eat. It was bought by the butchers at 5d. a pound, and they declared it was excellent, and sold it in London at 7d. He had eaten of a leg of mutton which had been kept seven days after it came out of the refrigerator, and it was excellent. These countries, therefore, would not only supply England with wheat for bread, but also with meat.

Mr. Julian E. Salomons, late Attorney-General for New South Wales, said that though a personal friend of Mr. Forster's, he had listened with regret to some of the statements in the paper, which he thought were open to misapprehension or question. The earlier remarks of Sir Robert Torrens indicated that they might lead to a most erroneous impression as to the real state of society there. He continued at some length to insist upon the high character of colonial officials, especially the occupants of the judicial bench, whom he declared were equal in character, talents, and learning to any one of similar position in England.

Mr. Pfoundes, also having lived in Victoria from his boyhood, desired to confirm this statement. He had come hoping to hear something about the class of persons who should go out to the colonies, and what they should do on getting there; and still hoped that on some future occasion Mr. Forster would give them the benefit of his experience in that direction. He might venture to suggest that the colonies were a first-class training school for young men of a superior class, and were not merely an outlet for surplus population; and that even the home country would benefit by more frequent visits from colonists.

The Chairman said all would agree that the paper had been drawn up in terse, able, and in some respects, most eloquent language, and did great honour to Mr. Forster, but he must unite to a certain extent in deprecating the possible tendency of some of its expressions. At the same time, he agreed with him in many points; for instance, that the Australian colonies owed a great deal to the establishment there originally of convict settlements, without which their development would certainly have been much retarded. Sir Robert Torrens and some of his friends, who so warmly advocated the Wakefield system, hardly did justice to the older colonies, without the previous existence of which they would have been unable to obtain their supplies of

sheep and cattle. The first merino sheep were imported by Mr. McArthur at great expense in 1818, in New South Wales, and it was not until 30 years after that South Australia was founded. He did not advocate a renewal of the convict system, and was glad to see it abolished, but he was quite sure that in its day it had been most beneficial, both to the convicts themselves, and to the colony, which ought not in any way to be considered disgraced by it. The same thing formerly took place in America; and, in fact, it was in consequence of the independence of the United States being declared, that the idea was suggested of sending convicts to Australia. He endorsed all Mr. Salomons had said as to the high character and ability of the members of the judiciary in New South Wales, and he must join in the expression of regret that Mr. Forster had not taken up the subject of emigration, and the reciprocal advantages which it afforded to both the mother country and the colonies. At no time in the history of England was the question of more pressing importance than at the present moment. During the last 70 years, the population of England had rapidly increased; it was still increasing, at the rate of 1,000 per day, and this ought to be checked, or great misery would be the result. Urgent appeals were being made on behalf of the starving Irish, and, of course, those who were perishing with hunger must be relieved, but anything beyond that would only add to the misery of the people. In Ireland, there were six or seven millions of people, crowded on an island a great portion of which could never be made available for human support. All sorts of nostrums were suggested as to how boys should be trained, and different systems of agriculture adopted, but they did not meet the great question. The evil would increase, unless there were some systematic arrangement by which this perpetual increase of population could be moved to where there was abundance of unoccupied land. The proper mode of relieving a redundant population was emigration, and funds ought to be provided for the purpose. They had just learned that, in Western Australia, Mr. Forrest had discovered a large tract of country—20 millions of acres—as large as Ireland, which he described as being of first-rate character, and traversed by a river navigable for some 20 miles. There were 20 millions of acres with nobody on them, and in Ireland there was an equal area, with a population subject to periodical starvation; would it not be wise to remove the people from the one country to the other. He had read of a case of a man and wife, with five children, being ejected from a farm of five acres; was it not a mercy to eject them from such a position? He agreed that prudence should be observed in selecting emigrants, and did not advocate the sending out of skilled mechanics and professional men, but for those who could dig and reap there was ample scope. Food was very cheap, beef being 1¼d. a pound. 400,000 tons of wheat came from Australia this year; and he was told by a gentleman engaged in commerce that, in a year or two, there would be three or four hundred vessels leaving Australia, each bringing home thousands of tons of beef and mutton. Sir Robert Torrens had conferred a great benefit upon the colony in effecting a system of cheap and easy registration and transfer of land, but a fatal mistake had been made in transferring the administration of these enormous territories to the mere handful of men who happened to be there first, and who, in many instances, by their antecedents, character, and position, were necessarily unfit for the exercise of such a trust. It was a great pity that in this matter the Home Government yielded to the clamours of certain people in the colony, who were determined to have a representative Government. He supported manhood suffrage at one time, but was now convinced that this was a mistake. He could only hope that now this large territory had been discovered, the authorities at home would be wise enough to keep the administration of it in their own hands, and should be very willing to form part of a deputation to the Colonial Minister on the subject.

Mr. Salomons wished to point out that at the time the convict settlements were established, persons were transported for offences for which they would now be merely imprisoned for a week, or, perhaps, let out on their own recognisances; stealing in a dwelling-house to the amount of 5s. being then a capital offence.

Mr. Forster, in reply, said he should indeed regret if he had said a word which could give pain to anyone. He had not intended to state anything but the truth; but he feared that some of his remarks might have been somewhat misconceived. His intention was really to suggest that the tone of public life in New South Wales tended to deteriorate—a view however, which he could not enlarge upon without going into personal details, which would not be becoming.

The Chairman then proposed a vote of thanks to Mr. Forster, which was carried unanimously, as was also a similar compliment to the Chairman, proposed by Mr. Salmons, and seconded by Mr. Pfoundes.

TWELFTH ORDINARY MEETING.

Wednesday, February 25th, 1880; James C. Stevenson, Esq., M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Bakewell, Herbert James, 60, South Hill-park, Hampstead, N.W.
Clarke, Frederick N., 3, Bolt-court, Fleet-street, E.C.
Collins, C. R., Hele, Cullompton, Devon.
Dunn, John, 53, Brown-street, Manchester.
Gamble, Josias Christopher, St. Helen's, Lancashire.
Hodgson, John S., Hexham.
Somerville, William, Belvoir-street, Leicester.

The following candidates were balloted for and duly elected members of the Society:—

Barneby, William, J.P., Saltmarshe-castle, Bromyard, Hereford.
Hodd, Richard, jun., 30 and 31, Hatton-garden, E.C.
Lyon, C., Oakleigh, Sunninghill, Berks.
Mondy, Edmond Felix, 36, Casella-road, New-cross-road, S.E.
Montague, Charles, 32, Cannon-street, E.C.
Muggeridge, R. W., Messrs. Barclay, Perkins, & Co.'s Brewery, Park-street, Southwark. S.E.
Norton, George, M.A., F.R.G.S., 2, Gloucester-place, Hyde-park, W.
Oakeshott, Jonathan, 4a, Sloane-square, S.W.
Tennant, Charles, M.P., The Glen, Co. Peebles.
Warner, Thomas, 47, Sussex-square, Brighton.
Whitworth, Frank Hoyland, Ormside-house, Upperthorpe, Sheffield.

The paper read was—

THE NOXIOUS GASES BILL.

By E. F. Muspratt, F.C.S.

A paper on the "Noxious Vapours evolved in certain Manufacturing Processes, with special reference to the Report of the late Royal Commission," was read before this Society a year ago by

Mr. A. G. Phillips. This paper dealt very ably with the report of the Royal Commission, and touched upon the action taken by certain associations for the controlling of noxious vapours, to influence the Government to go beyond the recommendations of the Commission in the Bill they were about to introduce into Parliament. Shortly after the reading of the paper, the President of the Local Government Board introduced a Bill professedly carrying out the recommendations of the Royal Commission, but, unfortunately, containing two or three clauses which could not be accepted by the alkali manufacturers, although they were then, as they have always been, disposed to aid the Government in legislating for the suppression of noxious gases, so far as such legislation was compatible with the carrying on of the various industries essential to the manufacturing supremacy of this country. I propose, this evening, again to draw attention to the subject, as we have every reason to believe that the Bill now being introduced by Mr. Selater-Booth is not essentially different from the Bill of last session. The points on which the alkali manufacturers laid stress are great questions affecting the principles of legislation, and a debate in this Society will, I trust, not be without influence on public opinion as well as on Parliament.

What can, and what cannot be done towards the suppression of noxious vapours, emanating from chemical and other works, has now been well ascertained, and if more of our legislators had had a scientific training, there would be less difficulty in framing a measure which would be satisfactory to the public and to the manufacturers. The difficulty our legislators experience in understanding this question, is well illustrated by an article which appeared in the November number of the "Nineteenth Century," on the Noxious Gases Bill of last session, by Lord Midleton, who was himself a member of the Commission appointed in 1876 "to inquire into the working and management of works and manufactories from which sulphurous acid, sulphuretted hydrogen, and ammoniacal or other vapours and gases are given off; to ascertain the effect produced thereby on animal and vegetable life, and to report on the means to be adopted for the prevention of injury thereto arising from the exhalations of such acids, vapours, and gases," and it was on the recommendation of this Commission that the Noxious Gases Bill of last session was professedly based.

As Lord Midleton's article embodies the views held, not only by some of the members of the Commission, but by Lord Derby and others, who have pressed their opinions upon the Government, I cannot do better than attempt to controvert its arguments, particularly as similar views have been given to the public in articles in the *Times* and *Saturday Review*, without hitherto eliciting an answer. Moreover, as the arguments are mainly used against alkali works, I can deal with them as an alkali manufacturer, having a full knowledge of what is, and what is not possible in suppressing nuisance from these works, and in so far as general legislation is concerned, with the experience gained during the preparation and passing through Parliament of the Bills of 1863 and 1874.

I will now briefly call attention to the history of legislation on this subject.

By the Alkali Acts of 1863 and 1874, all alkali manufacturers were required to keep the escape of the muriatic acid evolved in their manufactories within certain narrow defined limits, as well as required to use the best practicable means of preventing the escape of the other noxious gases produced by them. Other manufacturers, on the contrary, though evolving the same gases, were under no such restrictions. The object of the Commission was to ascertain if similar provisions to those which had been found to be so valuable with regard to muriatic acid, could be applied to all other noxious gases in whatever manufacture they might be evolved.

It was shown before the Commission that the majority of the alkali manufacturers had assisted the Government both in 1863 and 1874 to make the measures then passed as efficient as possible, consistent with a due carrying on of their important trade, and that the alkali trade had incurred a great expense, estimated by one witness at £200,000, in improving apparatus to enable them to comply with the provisions of the Acts. It was also admitted that they had in a great majority of cases done all that was possible to comply both with the letter and the spirit of the Acts. Many of the alkali manufacturers gave evidence before the Commissioners, and pointed out how they thought the Acts already passed could be more efficiently worked, and how other annoyances not satisfactorily dealt with by those Acts could be best remedied in the future, while the representatives of other trades objected to the extension to them of the inspection under which the alkali trade has been for so many years working. The alkali manufacturers have on every suitable occasion, before the Royal Commission and elsewhere, declared that the existing Alkali Acts, if thoroughly carried out, are perfectly capable of dealing satisfactorily with all avoidable escapes of noxious gases from alkali works; and in order that the Acts may be carried out with the requisite efficiency, they have recommended—

1. That the number of inspectors under the Acts should be increased, and that new and increased stringency in the maximum limits of escape allowed should be from time to time enforced, as improvements in the manufacture permit.

2. That the inspectors should continue to be men of scientific culture and independent position, appointed by and responsible to the Central Government, and not in any way connected with any local, sanitary, or other authority.

3. That sulphuretted hydrogen from waste heaps should be considered a noxious gas for the purposes of the Acts, and that these waste heaps should be placed under the supervision of the inspectors. The alkali manufacturers believe that the uncontrolled escape of sulphuretted hydrogen from these deposits has been the most fertile cause of complaint on the part of residents in the suburbs of Liverpool.

When the report of the Royal Commission appeared, the alkali manufacturers took the first opportunity of informing the President of the Local Government Board of their substantial acquiescence in the recommendations of the Commission, protesting at the same time against the adoption of the suggestion made to the Board by deputations that had waited on them, viz., that

collective liability for all damage done by noxious gases in any district should be imposed on all the manufacturers therein. They also pointed out that schemes with this object which had been proposed to the Commissioners by some of the witnesses, had been, after full consideration, deliberately rejected.

To their surprise, when the Bill was introduced, it nevertheless contained a clause embodying this new principle of law, and this clause was so clumsily worded that, instead of providing that manufacturers should be collectively liable for the injury done, it imposed upon any two or more manufacturers that a complainant might choose to select for attack, the whole liability for the injury sustained.

Lord Midleton, in his article, states that the bill "was accepted, when first introduced, by the manufacturers, as upon the whole an equitable settlement of the question. By degrees, however, as they began to perceive that time was on their side, it was understood that their objections increased."

Although the Bill applied to many other trades than the alkali trade, yet from the tenor of the whole article, and the numerous specific allusions to technical matters connected with the alkali trade alone, the public will draw the conclusion that it was the opposition of members of the alkali trade to which Lord Midleton refers as having prevented the passing of the Bill.

So far was this from being the case, as regards the alkali trade at least, that the manufacturers sought a second interview with the President of the Local Government Board as soon as possible after the Bill was printed, and explained to him their grounds of objection to this clause; and, in reply to the suggestion that any necessary amendments might be made in committee, stated that this point was of so vital a nature that they must object to the Bill being read a second time until they knew how this clause was to be modified, but that the other alterations they thought necessary could be discussed in committee.

It will thus be seen that the only ground on which the alkali manufacturers objected to the second reading of the Bill was its divergence from the recommendation of the Royal Commission on this one point.

Instead of availing themselves, as alleged by Lord Midleton, of the advantage of "time being on their side," in pressing their objection, they were most anxious that a Bill in accordance with the report of the Commission should pass during the session, and down almost to the day of the abandonment of the Noxious Gases Bill they were urging on the Government the propriety of withdrawing the provisions that had been added to the recommendations of the Commission, so that the parts of the Bill carrying out their recommendations, and comprising all the direct provisions for diminishing the annoyances occasioned by noxious gases, might pass into law.

The object of a Noxious Gases Bill is avowedly the mitigation (not the absolute suppression, for that is impossible) of the evils resulting from the emission of gases injurious to health, or destructive to vegetation, in the carrying on of certain industries which are absolutely essential to the existence of this country as a manufacturing nation. So far as injury to health is concerned, the Public Health Act seems to give all the powers necessary for the suppression of avoidable nuisances, and the Noxious Gases Bill of last session was intended to do the same for those which are injurious to vegetation. Two ways have been suggested to attain this object, the one direct, the other indirect. The direct method is by a proper system of inspection, to enforce the adoption of the best practicable means for the condensation of noxious fumes wherever produced, and if this were rigorously carried out, and made applicable to all works, all that the interests of the public require would have been attained. But the advocates of extreme legislation on this subject are not satisfied with this. Pressure has been brought to bear on the Government to attack the evil indirectly, and hence the introduction of Clause 29 of the Bill of last session, which embodied the principle of collective, or, as Lord Midleton calls it, joint and several liability.

It is remarkable that this principle has found favour with and support from sanitarians, as indicated by a leading article in the *Lancet* of 29th November, which was ably replied to by Mr. Eustace Carey; but it is difficult to see of what use such a clause would be, as the Public Health Act enables sanitary authorities to suppress any nuisance injurious to health; and I am glad to see that the *Lancet* is now of opinion that it would probably be better to drop the clause altogether, than to run the risk of again making shipwreck of a much wanted sanitary reform.

The idea that it is impossible to proceed against more than one offender in a joint action is erroneous, as pointed out by the Royal Commission, who drew attention to the clause in the Judicature Act, which enabled a plaintiff to join a number of defendants in one action, instead of bringing several actions; and it will be interesting to know that on January 16th of this year, a case of this kind was brought before Mr. Justice Lush, at Newcastle, and the damages were given against three defendants to the action. It behoves us, therefore, to consider well this so-called vital principle, in order to see whither it will lead us. It may be considered from a practical point of view, viz., as to whether it is likely to attain its object, and from a legal point of view as a question of justice. I propose to consider it in both aspects. As to the practical question—the application of this principle will be different if it applies only to gases which are destructive to vegetation or growing crops, or to vapours which are, to use the words of Lord Midleton, simply offensive to the smell. Now, it is remarkable that this principle of collective liability has been most strongly insisted upon by those who do not suffer from any appreciable damage to vegetation, but are simply annoyed by the offensive effluvia from the waste heaps near Widnes, and from the Sankey Brook which flows past St. Helens.

Yet this is precisely the nuisance which can only be effectually dealt with directly, and the race after this phantom of collective liability put a stop to the passing of an Act which, undoubtedly, if properly carried out, would have greatly reduced the nuisance complained of. Making manufacturers collectively liable for the annoyance from bad smells would be of no use whatever, unless

powers were given to them over other people's property, for example, power to interfere with railways and other companies who use the alkali waste for the making of roads and embankments, and with farmers, who use it for manuring their fields. This is no fanciful suggestion, but absolute fact.

The nuisance complained of in the suburbs of Liverpool arises from the sulphuretted hydrogen given off by the waste deposits, and these deposits, with few exceptions, are not under the control of the manufacturer; but the manufacturers, as stated above, proposed to place these waste deposits under the control of the inspector of alkali works, and suggested certain regulations, approved by the Commissioners, which would diminish the nuisance as far as practicable. Lord Midleton and others, not content with this, desire to introduce a clause which will make the manufacturers, as a body, collectively liable for the annoyance or nuisance—unless, indeed, the collective or joint and several liability is distinctly limited to gases which are directly destructive of vegetation.

But if the facts of the case are as above stated, how will the residents in the suburbs of Liverpool and those affected by the Sankey Brook, be any better off with such a clause in the Bill, a clause for which, nevertheless, they are willing to sacrifice all the rest of a measure which may afford them some remedy?

From the foregoing it will be seen that to make manufacturers collectively liable for bad smells would in no way improve matters in the interest of the public, while it would run the risk of driving away some of the most important manufactures of this country to other countries where the inhabitants are willing to submit to a certain amount of annoyance on account of the many advantages accruing from chemical manufactures.

Upon this point Lord Midleton has some very excellent remarks:—

"The statesman would deserve ill of his country who could shut his eyes to the narrowness of the margin which enables England to face successfully the fierce foreign competition by which she is menaced on every side. No fact stands out more prominently in history than the difficulty of resuscitating any industry that has once been driven away, no matter how, from any particular locality."

These contingencies he seems, however, to have forgotten when treating in an off-hand way the great question of collective liability. For if residential damage arising from these bad smells is brought home to manufacturers collectively, it is clear that every one who felt himself annoyed by a bad smell would seek compensation from manufacturers collectively, and the amount of compensation would very soon be large enough to ruin any trade.

Let us now consider the effect of a joint and several liability clause, restricted to damage to vegetation caused by the emission of noxious gases.

From the evidence given before the Royal Commission, it appears that alkali works are by no means the worst offenders, but that copper, glass, salt, and other works emit these injurious gases in equal or greater proportion than alkali works.

Lord Midleton says:—

"The prime agents in mischief to vegetation are hydrochloric, nitric, and sulphuric acid. Of these the last is probably the worst offender of all, and assuredly the most difficult with which to deal."

To make a joint and several liability clause in any way equitable, therefore, it will be necessary, in apportioning the damage, to include the damage done by coal smoke from every domestic hearth, as well as from every boiler chimney; for it must be ever borne in mind that the damage of which we are speaking is damage arising from the aggregate of these gases from various sources.

It was proved clearly before the Commission that the damage from well managed alkali works was not appreciable at a very short distance from the works if these works were isolated, and that, therefore, damage near a manfacturing town arose from the accumulation of these gases, and was largely due to coal smoke.

Bearing this in mind, it seems clear that this damage, of which residents near Liverpool and Manchester complain, is what takes place in the suburbs of every large town as it constantly extends its boundaries. The lands and gardens in the suburbs of manufacturing towns are thus gradually rendered less productive, and the amenity of suburban residences is impaired as the consumption of coal increases. There is a compensation for this in the increased value of the land, and in the improved market for agricultural produce, but the law has not provided special facilities for recovering damage for the loss of crops and fruit.

Why, then, it may fairly be asked, should a new principle of law be introduced affecting a certain number of manufacturers only, and those not necessarily doing more damage individually than others who will remain exempt from its operation?

If the principle is just, it ought to be universally applied. But if it cannot be made universal, as seems to be tacitly admitted, it is clearly necessary, in order to make the clause in any way equitable, to provide that all the damage due to ordinary coal smoke must be deducted from the total damage before apportioning the balance amongst the various manufacturers emitting other noxious gases.

I will not dwell upon the difficulty of apportioning the damage equitably amongst a variety of manufacturers, which must be apparent to every one, but consider whether under such a system the collective damage might not be increased rather than diminished.

It is well known that the escapes of noxious gases from chemical and other works can only be effectually prevented by the expenditure of capital on complete apparatus; and wherever of late years, since the passing of the Alkali Acts, any serious damage has been done, apart from the collective damage due to coal, smoke, and other manufactures, it has been done by works that have been erected and worked with insufficient plant.

Lord Midleton, with that fair intention which is apparent in the whole tone of his article, admits this fully; but is it not strange that he overlooks the fact that, if all are put on the same level, and made collectively liable for damage, there will be no inducement to work up to a higher level, or to introduce improvements which are not directly remunerative?

By lessening individual responsibility, one in-

centive to good working is diminished. If manufacturers are to be made responsible for other people's misconduct, all honest and responsible mer will be driven from the trade, which will pass into the hands of unscrupulous persons, who will avail themselves of the facilities to evade responsibility by the Limited Companies' Act. Injury to vegetation, and nuisances, which by more rigid inspection may be lessened, provided manufacturers are honest and willing to co-operate with the inspector, will very probably be increased, as the personal supervision of individual owners directly responsible for their own misdeeds is transferred to those whose only desire is gain and profit, without any consideration for the public at large.

I have hitherto considered the question of collective or joint and several liability in the abstract, and it will be seen how difficult, if not impossible, it is to frame a clause, or introduce the principle into our system of jurisprudence with any regard to equity.

But in the Bill introduced by the Government last session, this principle, I have no hesitation in saying, was introduced in the worst possible form.

The 29th clause provided that—

"Where a nuisance arising from any noxious or offensive gas or gases appears to be wholly or partially caused by the acts or defaults of two or more persons, any person injured by such nuisance may bring one action against all such persons, and shall be entitled to the like remedy by injunction, damages, or otherwise, against all or any of such persons as he would be entitled to against a single person, notwithstanding that the action or default of any one of such persons would not separately have caused a nuisance, and any damages recovered and the costs may be distributed in such a manner as may appear to the Court fair and reasonable, and the person bringing such action shall not be disentitled to recover by reason that the nuisance partly arises from the acts or defaults of some other person or persons who have not been made parties to such action."

Every lawyer of eminence who considered it, saw at a glance the flagrant injustice of the clause which was interpreted by eminent counsel to mean, that—

"Under this clause, any two or more works giving off the same gases as are evolved by the combustion of coal, could be singled out and sued for damage sustained by a farmer, mainly from other works in the same locality, and if the jury could be persuaded that the smoke from the works so proceeded against had contributed, even infinitesimally, to the injury sustained, they would be bound to find a verdict against those works for the whole of the damage, while the works so attacked would have no remedy against the other works which, though doing the greater part of the injury, had not been included in the action."

In ancient times, when trial by ordeal existed, and justice was administered with the aid of red-hot ploughshares, districts were made responsible for the acts of individuals. By this clause it is proposed to reverse this order of things and make individuals responsible for districts. The clause would seem to provide for an equitable apportionment of the damages among the defendants, but it must not be forgotten that all the damage done by a multitude of works would be apportioned among the two defendants supposed to have been singled out, and that they alone would be left to bear the burden of the whole damages and costs, without having any right to claim contributions in aid from their neighbours who had joined in the alleged injury.

Now, was the alkali trade justified or not in strenuously opposing such a monstrous clause on the second reading? Everyone familiar with the way in which the House of Commons goes through committee on minor Bills, at one o'clock in the morning, knows that any clause, however bad, may be carried in committee without real discussion if the Government supports it, and there are enough impracticable and inequitable clauses in our statute book already without increasing their number.

The supporters of the principle of collective liability have frequently stated that their object is only to make individuals responsible for their proportion of the damage sustained, and they endeavoured, with the help of an eminent lawyer, to draft a clause to secure this.

Now, I do not say that such a clause might not be drawn, and, if carried out as intended, might be equitable. But not one of the would-be legislators has considered how such a clause would work in practice, and those who have had experience in actions for damages against chemical and other works, are aware how impossible it would be in most cases to act fairly in the apportionment of the damage.

In any case, it would be to the interest of the plaintiff not to bring his action against the works which had done the most injury, but against those owners who were best able to pay damages.

If the evidence of experts were accepted, the defendants would most likely be able to prove that their share of the damage was exceedingly small, but the verdict would have to be given against them, and the costs of the action would have to be borne by them. This would be a fruitful source of litigation; for such a thing as cases being got up by attorneys for their own benefit is, unhappily, not unknown, and if practitioners of this order were secured their costs beforehand, such cases would be enormously increased. Farmers who suffered from bad seasons would also be tempted to bring actions against manufacturers, as it would be nearly impossible to show that no damage was done by an aggregate of works, although the plaintiffs most likely would have already secured compensation in the increased price of their produce, assisted by the proximity of the manufacturing town.

Before leaving this subject of collective liability, I cannot but express my regret that an influential deputation has again waited upon the President of the Local Government Board, to urge upon the Government the necessity or desirability of making manufacturers collectively liable.

With the exception of Lord Derby, who appears to have considered the arguments of the manufacturers, all the other speakers on the deputation seem to be as much in the dark as ever. For instance, Sir C. Mills, representing the South Eastern Sanitary Association, says, "Unless that 29th clause be introduced, which enables contributory proceedings in the case of suppressing nuisances to be adopted, we should not be successful, because in our case we have got the factories on the north side of the Thames, very close together, and the

vapours are mixed, and it has been found over and over again how difficult it is to reach any one person."

But he does not explain how the 29th clause would help the Sanitary Association, unless, indeed, it resulted in closing all the manufactories complained of. Surely, what he wants is not the suppression of the factories, but the suppression, as far as possible, of the nuisances arising from them; and it is clear that can only be done by bringing all these factories under inspection, and insisting that every practical means for the prevention of the discharge into the atmosphere of offensive gases shall be adopted. To render those who had already applied such means, responsible for those who had not done so, would only, to use the words of Lord Derby, "be a discouragement to those who have done their best to improve their process, because it puts them on a level with those who have done nothing to mitigate the mischief which they create." Lord Derby evidently sees the force of this argument, and proceeds to say, "I think there is an answer to that, and it is this, that most persons would be content that it should be allowed to be pleaded, as a sufficient defence in the case of any one particular work, that the owner of that work has adopted the best process known, and has done all that he reasonably could to prevent his work becoming a cause of injury or annoyance." Now, this sounds fair and plausible, but we must consider how it would work in practice. The nuisance complained of by Sir C. Mills does not arise from alkali works, where most of the offensive gases can be condensed, and a limit of maximum escape is fixed by law, and it is unlikely that a jury would be able to distinguish the well conducted from the badly conducted works, unless there was some clearly defined limit to guide them. The clause would probably lead to protracted and expensive lawsuits, with interminable evidence by experts on the part of each individual manufacturer; and the jury, unable to discriminate, would give their verdict against all. Even if a particular manufacturer was successful in availing himself of the plea Lord Derby suggests, he would only be so after incurring enormous costs, which he might be unable to recover from the plaintiff.

This would not suppress the nuisance, for one manufacturer has no power over the doings of his neighbour, and the result would be a discouragement to those who had tried to do their best to mitigate the evil. The more this subject is considered, the greater the difficulty of making such a clause equitable in practice; and I regret to see, from the reply of Mr. Sclater-Booth to the deputation, that, in his Bill of the present session, this clause is not to be expunged altogether, but that the language of the clause, which was made with so much difficulty last year, may be a good deal simplified and made more easy.

The Alkali Inspector's report for the years 1877-78 has lately been published, and the following observations will be of interest, as they show clearly the advantage of the direct method for suppressing nuisances.

Speaking of the various noxious gases coming from alkali works, the Inspector says:—

"In other words, muriatic acid has been conquered to a great extent than the law anticipated, but there are still arrangements to be made before we can look with entire satisfaction to every portion of the work." .....

"The acidity of some chimneys using coal only is little above 0·2, and yet coal does decided injury when works are concentrated. The muriatic acid is not in this comparison very small, if it is not below the standard of 0·2, but the number of chimneys giving out muriatic acid is trifling to these giving out sulphur acids. Still, it is not well to stop at any point except perfection, since there will always be some persons who will fall short of the aim, if, indeed, everyone will not do so at times; and I quite think that it would be wise to take a second step as soon as the present is familiar to every one. The public can scarcely imagine what a step in advance signifies to the manufacturer—what expense, what change in apparatus, what teaching of men, what annoyance to foremen, what trouble to chemists, what complicated disturbances in the minds of managers, and what anxiety to owners, but it must be taken occasionally.

"A good deal of work has been done, but the great question comes to me often as to the public—to what final issue? Do trees grow where none grew before? This can only be said to a small extent, and it is clear that in all South Lancashire there is a lowering of the tone of vegetation; it is less sturdy, and the trees are less beautiful. I see this, and I labour in the contracted field of chemical works, repressing some evil, doing some good, I think, but not so much as I wish, for I see that it is invention that is required, and not inspection merely."

Upon the nuisance arising from sulphuretted hydrogen the report is less satisfactory, because, as I have pointed out, the waste deposits, except when forming parts of alkali works, do not come under the Inspector's control. "I have given," says the Inspector, "a great deal of time and thought to the question of sulphuretted hydrogen; and if I am not successful in producing a process which will please the manufacturers, and enable them to treat the soda or tank waste in a satisfactory manner, I am at least able to communicate some information which will be valuable." After describing the proper mode of depositing the waste, he says, "The alkali manufacturers rely very much on this operation, and I am compelled to say that, when it is skilfully done, it is a success." With this information, I have no doubt that, so soon as these deposits are placed under control, as desired by the alkali manfacturers, the nuisance will be very much diminished.

I have considered the whole subject chiefly from the alkali manufacturer's point of view; but it must be borne in mind that this Bill not only affects alkali manufacturers, but almost every industry of this country, with the exception of the manufacture of textile fabrics. Is it likely that these will be idle and submit to such an unjust and inequitable clause, as the 29th before alluded to? Lord Midleton is quite right in saying that an opposition sprang up at a late period of the session which was fatal to the Bill, but it was the opposition of the manure, glass, salt, and copper manufacturers, who, when the Bill was first introduced, did not realise that it applied to them as well as to the alkali manufacturers. The Bill contained other clauses besides the 29th, to which objections might fairly have been taken, and which would require amendment, but they were not of such vital importance as to require discussion on the second reading of the Bill, and being of a more or less technical nature, are not of general interest.

I regret not being able to deal with the Bill of

this session, as it is not yet in the hands of the public, though according to Mr. Sclater-Booth, it is said to be very similar to the measure of last year. My objections, and those of my fellow manufacturers, however, go against the principle, and not against the wording of the Clause 29, and I am afraid it will again be our duty to oppose it. Whatever is worth doing, is worth doing well, and I quite agree with Lord Derby that it is desirable that the Bill which the Government proposes should be one of a character likely to deal effectively and permanently with the evil. What is unjust can never be permanent, and, I trust, the Government will amend the Bill, so as not to impose more burdens on manufacturers than are absolutely necessary for the protection of the public, and that it will take care that no such inequitable provision, as the 29th clause of the Bill of last session, shall again be permitted to be introduced into the present measure, through the influence of those who prove themselves by their public utterances to be incompetent to deal effectively or justly with the subject.

DISCUSSION.

Sir John Morris (Chairman of the Manure Manufacturers' Association) said Mr. Muspratt had dealt so completely with the objectionable 29th clause, that it was hardly necessary to add anything with regard to it, and if his views could be brought to bear on the Legislature, so as to modify this clause, if not expunge it altogether, they would obtain what they desired. The 27th clause was objected to in connection with the Bill of last session, which gave the local authorities power to question the competency of the inspectors; but he was glad to know that the Government had seen the unreasonableness of such a clause, and that it was intended to take the entire control out of the hands of the local authorities. It must be obvious to all, that if officers of health and local authorities were allowed to exercise any influence, it would much perplex the manufacturers. With reference to the 29th clause, which involved the united responsibility of all parties concerned where a section of the manufacturers had done all that could be done, it seemed the most unjust and extraordinary procedure which could be contemplated by any Legislature. Speaking for the manure trade, there was not a single manufacturer who did not desire that an inspection should take place, and that all should be required to adopt the best scientific measures known to mitigate whatever nuisance arose from such manufacture. He was equally sure that the principles which had been adopted by the largest makers had been eminently successful, and it would be most unjust that they should suffer for the neglect of those who had less sensibility to their duty.

Professor Heaton said he represented what might be called the other side of the question; he had given evidence before the commission, and formed part of the deputation to the Local Government Board; but, for all that, he could not say he disagreed entirely with the remarks made by Mr. Muspratt. He had never been a warm advocate of the 29th clause; and the recent case at Newcastle, which showed that the power of enforcing a claim against manufacturers collectively already existed, altered the position very much indeed. He should be quite prepared to waive the clause rather than risk the failure of the Bill. He had always admitted that the manufacturers met the question in the most upright and honourable manner, and showed a desire to do what was right. With regard to Clause 27, he thought the fears of the manufacturers were a little unreasonable. As things stood at present, the clause could hardly be expected to do either good or harm; but it referred to the possibility of action being taken by the local authority, in default of action by the chief inspector. Now, if the chief inspector declined to act, there would be such a *primâ facie* case in favour of the manufacturer, that the local authorities would be very slow indeed to interfere; and, if they did, they would have the evidence of the Government inspector against them, so that the manufacturer would be pretty safe. But the time might come when the chief inspector—from old age or some other cause—would be much less efficient than the present one, then the law might simply fall into abeyance, and any amount of nuisance might be inflicted. In such a case, the sanitary authorities might surely be allowed to interfere at their own risk. He was convinced they would never do so under ordinary considerations; and, if they did in ordinary cases, they would have no chance of success.

Mr. Wm. Botly agreed generally with the tenour of the paper. They must all concede that, as a manufacturing nation, it would never do to adopt measures which would drive some of our manufacturers out of the country. As an owner of land, he knew that his few acres had increased in value by proximity to a town, while his tenant had compensation in the proximity to a good market for his produce, by which the price, especially of garden produce, was materially increased. He could also corroborate what had been said about manures. He had used alkali and refuse on his farm, when he occupied it himself, with considerable advantage, and it was certainly not more of a nuisance than farm-yard manure, if so much. The sooner it was ploughed in the better, and it was only a nuisance when lying on the surface, the same as other manures were. He hoped the suggestions made would meet with the approval of the Legislature.

Mr. Henry Allen wished to say a word on the use of alkali waste as manure, All who lived in the neighbourhood of Widness and St Helen's knew that it was the sulphuretted hydrogen arising from the waste, and the pollution of the brooks, which formed the greatest nuisance to the district. The blue scum lay for miles around, for he had collected it from the surface of a lake, which had been frozen over, two or three miles from St. Helen's. This was very injurious to plants; on a damp morning it lay on the leaf, and when the sun rose it disappeared, but the sulphide was then converted into sulphate, and ate into the leaf, in many cases a hole being actually made into it by this corrosive material. Now that the muriatic acid was so largely condensed, the sulphur evolved from the waste was the most injurious thing they had to contend with, and that being so, they could but hail with great satisfaction the extensive use of this substance by farmers as manure. Its use had increased from 1,200 tons last year to 10,000 tons this, and it was being used by some of the best farmers, well-known in the agricultural world. They found that all crops and almost all soils were benefited by it. On heavy clays it made the land lighter and more easy to work; and potatoes were found to come more freely away from the soil. Mr. Whalley told him he had proved this by using it on one part of a field, and not on the other; and it also acted very favourably on oats, wheat, and grass. On light land it had been found especially valuable for mangolds as well as turnips. Farmers had told him that there was no need to take any trouble to recommend it, for people would soon find out its value. It was an interesting question how the manure operated: it was principally sulphide of calcium, and should be put on the land at the end of the year. He did not agree with the last speaker that the sooner it was ploughed in the better; on the contrary, he considered the longer it was left the better; it became oxidised, by exposure to the air, into sulphate of lime, and on further exposure it became carbonate of lime, by absorbing carbonic acid from the atmosphere. For

farmers it was not an enriching, but rather an exhausting manure, and necessitated the use of more phosphates. He believed its action was to absorb ammonia and so increase the crop. Farmers in the neighbourhood of Widness had found that all crops and all lands were greatly helped by the liberal use of this substance, and he believed they would find in the end that the alkali manufacturer was their friend and not their foe.

Mr. Botly said his opinion with regard to ploughing in, applied especially to ammonaical manures and salt.

Mr. Allen said farmers were now using this substance very much for sprinkling on manure heaps, where it tended to fix the ammonia, rather than allow it to volatilise.

Dr. Hewitt thought the thanks of the Society were due to Mr. Muspratt for bringing forward this subject. The danger they suffered from was having this question dealt with by those who did not understand it. As soon as the public got to know that the manufacturers were not an unreasonable, grasping, avaricious set of men, perfectly regardless of their neighbours' feelings, as they had been regarded by some writers, they would be treated more fairly. All the alkali manufacturers had shown their desire to meet the wants of the public, by at once submitting to this special legislation. It was often urged by those who were asking for collective liability, that their whole difficulty was the grouping together of works, and that they could not get damages, because each one laid the blame on the others. But there were many instances to the contrary; and if the facts were examined, it would be found that, practically speaking, single isolated works had not been at all prominent in actions for damages, though, in their case, the proof was exceedingly easy. For ten years he had been managing works which had existed 50 years in the neighbourhood of Manchester, and during the whole of that time it had never been brought into a court of law. He had the strongest feeling that this collective liability clause was absolutely unnecessary, especially considering the recent case at Newcastle. The Acts under which they were working put them under heavy penalties if they did not do all that was possible; yet even strict compliance with those Acts did not protect them from an action for damages, and they were liable to be attacked as one of a number of persons who were doing that which, in itself, was no harm. If the amount of vapour sent out from one of these works was not capable of doing damage, why should the mere fact of a number of such works being in close proximity render them liable to attack? It seemed to him very unjust to the works which happened to be crowded together, as compared with the isolated ones. With regard to the clause for which one gentleman had expressed great admiration, allowing of interference by local Boards, he rather suspected that his experience was chiefly in London, and that he did not know that throughout the land there were local Boards possessed of very much less knowledge and intelligence. Unfortunately, in many cases, these local Boards were directly interested, either by the members being engaged in agriculture, or from local and political squabbles, and they were utterly unfit to deal with questions which demanded scientific knowledge, judgment, and forbearance; hence he feared that a great deal of the benefits of the Act would be destroyed if they were allowed to interfere. Looking at the matter broadly, these were the two great blots which required to be removed from the Bill; and as they were now told that the Judicature Acts gave the power to sue several defendants collectively, it would be a great pity to endanger the Bill by seeking to include a provision which was already in existence elsewhere.

Mr. Worsley (Bristol) thought there must be something more in the 29th clause than had been referred to, or there would not be so much anxiety to meet a case which was already provided for. If there was anyone present who could enlighten the meeting on the exact terms of this clause, as it stood at present, it would be very useful.

Professor Heaton said no one yet knew what the clause was; they only knew that the clause of last year was somewhat modified.

The Chairman said this question of Government interference with the industry of the country was necessarily one of a very wide character, and the alkali manufacturers had shown a great amount of public spirit in accepting, with the cordiality they had done, an amount of interference in their trade which they might very plausibly, and perhaps successfully, have resisted. He remembered, in 1863, Mr. Bright saying that if they chose to resist these restrictions on principle, he would assist them in so doing. But they thought it better to submit to reasonable legislation, based on proper principles. There seemed to be some danger of the great principle on which legislation was at first founded, and on which only it could be justified, being forgotten. It was the House of Lords Committee, on the instigation of the late Lord Derby, which first suggested this legislation. The difficulty was then adverted to of selecting the guilty manufactory in the middle of a large group, and the House of Lords Committee dealt with it. It repudiated the doctrine of combined liability, and went on another line altogether, the two principles being antagonistic. They said, if you go in for the principle of combined liability, you must give up the principle of individual inspection; but they adopted the latter as the sound principle, if carried out cautiously and judiciously, the other being unjust in principle, and he believed ineffective in action. The principle was, you may apply the law to enforce upon the unenterprising or careless manufacturer what had been proved to be practicable by the experience of the intelligent manufacturer; you may say to the negligent man, this has been done, it can be done, and in the public interest you must do it. That implied intelligent and careful inspection, such as they had been fortunate enough to have from Dr. Angus Smith. He had been found fault with by those who represented the landowners, and it was said he did not understand his work; but he ventured to differ from that view. The outside public wished to see manufacturers constantly summoned in the County-court and fined, but Dr. Smith saw a better way of acting. He did not hesitate to prosecute in extreme cases, but he much preferred, by a steady, gentle pressure, and by the influence of his valuable annual reports, to see what could be done. By this means, they had obtained an increased stringency of the tests applied to the gaseous escapes from chimneys; and so successful had this been, that with regard to the chief offender, muriatic acid, it was now no more destructive than the sulphurous acid issuing from any ordinary manufacturing chimney which used coal, which in this country contained such a large amount of sulphur with this important difference that, for every cubic yard of muriatic acid which escaped at that very weak degree of intensity, many hundred cubic yards of sulphur acids were given off, which no process was known to be able to prevent. So well had this system worked, that the manure manufacturers were coming forward and asking to be put under the same system of inspection. Probably, there were among them intelligent and enterprising men, who suffered for the bad processes of the negligent, and they repudiated this delusive principle of combined liability, and went in for the sounder principle of individual inspection, and asked that each should be required to adopt the best practical means of preventing the escape of offensive vapours, which had been the principal reason for the formation of the society which Prof. Heaton represented—the South Eastern Association for the Prevention of Noxious

Gases. The second great principle of the Legislature of 1863 was that of central administration, and they would be departing from that in giving local authorities any power whatever. What was required was very intelligent inspection, and uniform inspection throughout the whole country. If you allowed local Boards here and there, and ill-informed medical officers to interfere, you would have one standard in one part of the country, and another in another, and introduce confusion, which would result in failure. He trusted it would be found that the new Bill had largely modified this clause. With respect to the 29th cause, if they adopted the principle of combined liability, where would they be landed? The atmosphere of any manufacturing town was so largely charged with sulphuric acid, that it destroyed suburban gardens, and broke the hearts of those who tried to cultivate their flowers and peaches, where now they could hardly get even grass to grow. Every factory and every house contributed to the result, and if this doctrine were carried out, these residents would be able to combine against all the manufactories in the town, and get compensation for the loss of the pleasure they formerly enjoyed. If you once admitted the principle, it must go to that length. Mr. Botly said quite truly that, as a landowner, he got his compensation in the increased value of his land, but those landowners who were so anxious for combined liability wanted to have compensation twice over. He was very glad the Society of Arts had provided an opportunity for the discussion of the question, and he hoped the result would be beneficial.

Mr. Muspratt regretted that more of the opposite side had not taken part in the discussion, because he had hoped to elicit the arguments of those who advocated the 29th clause. He had over and over again asserted that this clause, in any shape whatever, would do nothing towards improving the health of the country, and he could not really understand why sanitary associations asked that manufacturers should be collectively liable. Professor Heaton said that now it was shown that the Judicature Act gave power to proceed against several defendants collectively --which was well known before—they did not require such a clause. But even that did not do them any good, as it would not prevent the escape of noxious vapours. The only way in which the 29th clause would act in the interests of health would be by shutting up manufactories altogether. If you wanted to do something in the interests of the public health, try and suppress the noxious vapours as they were given out in the factory. Mr. Botly said the waste was dug in directly, and, therefore, there was no nuisance from it; but he was informed that in the neighbourhood of Widnes it had been left lying in heaps, to cause a nuisance, and that, in fact, it was this which caused that nuisance many people attributed to the gases from Widnes. Therefore, the use of waste by the farmers would not absolutely destroy the nuisance, though, at the same time, there was no doubt it would not last long. The material was put on the land only at a particular time of year, and, as soon as it became mixed with the soil, all the offensive gases were absorbed. There had been some discussion as to how it acted as a manure, but he believed that had not yet been thoroughly investigated. There was no doubt that when exposed to the air rapid oxidation took place, and if that took place when mixed with the soil, it would, no doubt, disintegrate it, and make it in a better condition for yielding plant food. Again, no doubt, on heavy clay lands the sulphur combined with the iron, and made quite porous what was before a dense mass. Gypsum had been used almost from time immemorial as a manure, and the waste, when oxidised, became converted into the same substance. It was desirable that this subject should be investigated by agricultural chemists, who might indicate new uses for this substance, and point out where it could be used with advantage. He thought Professor Heaton did not quite understand their objections to the 27th clause as it was worded last year. It provided that any sanitary authority, or any ten inhabitants of a district, where a work was carried on so as to be a nuisance, must tell the chief inspector to proceed, and if he did not do so within a reasonable time, in respect of the alleged contravention of the Alkali Acts, they might apply to the County-court for an order to restrain the commission of such nuisance. Now, the Alkali Acts said that the amount of acid escaping from any works should not exceed a certain quantity; how were the ten inhabitants of a district to know whether the chief inspector had done his duty in respect of such a matter as that. When it came to such fine distinctions as 0·2 grain per cubic foot, they must have some one on whose testimony they could rely, and not be given over to medical officers, who were not, as a rule, well versed in chemistry.

Professor Heaton said his remarks seemed to have been misunderstood, and repeated what he had before said, that it was only in the event of a chief inspector declining to act, that this clause would have any value at all.

Mr. Muspratt thought that was a very good reason for omitting the clause, at any rate until the present chief inspector died. He would also point out that, under the present law, local Boards and corporations had full powers to suppress any nuisance which affected the public health. This Act was something in addition to the Public Health Act, and in mixing up these local Boards with an Act of this kind, which was a general Act laying down a new principle, under which manure works, glass works, copper works, and all works evolving noxious gases would be brought under legislation similar to that affecting alkali works, was perfectly unnecessary. As he understood the clause, it was modified in the present Bill so as to leave it the Local Government Board to take action, but to the clause in the last Bill left it to the County-court to insert directions as to the means to be adopted, or the time allowed for complying with the requirements of the order. The clause was altogether absurd, and he could not understand scientific gentlemen advocating it. It was quite certain that if men who understood the subject would come and discuss it with the alkali manufacturers, they would see that such action was not desirable. The only other point he need mention related to the Cheshire landowners. It was they who complained of Dr. Angus Smith, not the sanitary authorities. The suggestion both of the 27th and 29th clauses came from Cheshire landowners and lawyers. Because these landowners still suffered some nuisance, they said Dr. Angus Smith had not done his duty. In 1874, Dr. Smith suggested that they might work to 0·2 grain of hydrochloric acid per foot, and they then said that if that were done, everything would be right. The manufacturers said it was almost impossible to comply with that condition, and sometimes it was quite impossible, though it was not one-fifth of a grain, but 10 or 20 times that amount which did the damage; but, however, the Act was passed, and so far as the condensation of acid escapes was involved, had been successfully carried out. If the waste deposits had then been put under the inspector, the complaints of the non-carrying out of the Act would not have been made. It was because these gentlemen did not understand the question, and did not believe the manufacturer, who told them that the nuisance really came from the sulphuretted hydrogen, that they wanted to introduce these clauses. He asked those who had the health of the country at heart, not to be misled, but to try to act with those who desired to carry on their business with the least annoyance possible to their neighbours; and if they would only act together, he was convinced that an Act would be passed which would really benefit the country.

The Chairman then proposed a vote of thanks to Mr. Muspratt, which was carried unanimously.

MISCELLANEOUS.

ARTIFICIAL DIAMONDS.

Professor Story Maskelyne, who examined Mr. James Mactear's presumed "diamonds" (see *Journal*, Jan. 2, 1880, p. 105), has written the following letter to the Editor of the *Times* on those produced by Mr. Hannay:—

"Sir,—A few weeks since I had to proclaim the failure of one attempt to produce the diamond in a chemical laboratory. To-day I ask a little space in one of your columns in order to announce the entire success of such an attempt by another Glasgow gentleman.

"That gentleman is Mr. J. Ballantine Hannay, of Woodbourne, Helensburgh, and Sword-street, Glasgow, a Fellow of the Chemical Society of London, who has to-day sent me some small crystallised particles presenting exactly the appearance of fragments of a broken diamond.

"In lustre, in a certain lamellar structure on the surfaces of cleavage, in refractive power, they accorded so closely with that mineral that it seemed hardly rash to proclaim them even at first sight to be diamond. And they satisfy the characteristic tests of that substance. Like the diamond, they are nearly inert in polarised light, and their hardness is such that they easily scored deep grooves in a polished surface of sapphire, which the diamond alone can do. I was able to measure the angle between the cleavage faces of one of them, notwithstanding that the image from one face was too incomplete for a very accurate result. But the mean of the angles so measured on the goniometer was 70 deg. 29 min., the correct angle on a crystal of the diamond being 70 deg. 31·7 min. Finally, one of the particles, ignited on a foil of platinum, glowed and gradually disappeared exactly as mineral diamond would do.

"There is no doubt whatever that Mr. Hannay has succeeded in solving this problem, and removing from the science of chemistry an opprobrium so long adhering to it; for, whereas the larger part of the great volume recording the triumphs of that science is occupied by the chemistry of carbon, this element has never been crystalised by man till Mr. Hannay achieved the triumph which I have the pleasure of recording to-day. His process for effecting this transmutation, hardly less momentous to the arts than to the possessors of a wealth of jewelry, is on the eve of being announced to the Royal Society.

"I am, Sir, your obedient servant,

"N. Story Maskelyne.

"Mineral Department, British Museum, Feb. 19"

CORRESPONDENCE.

THE EUPHRATES VALLEY RAILWAY.

Had not time pressed so much last Wednesday evening, I should have desired to make one or two remarks upon this important subject.

Mr. Scott Russell, in condemning the idea of the trans-shipments of goods and their land transit across Mesopotamia, appeared totally to ignore the fact that for many years the great Peninsular and Oriental Company adopted such means in respect to the cargoes of their steamers across the Isthmus of Suez, and as is well known, with very successful results, pecuniary and otherwise. Similar measures had been taken previously by the private enterprise of the late Lieut. T. Waghorn, R.N., the indefatigable pioneer of the Overland Route, aided by his associates. I would, however, by no means say that under the existing circumstances of traffic, such trans-shipments, &c., of heavy goods could now be made profitable, but for mails, passengers, and troops, the projected route might prove to be of the highest utility.

Further, it seemed to me that in Mr. Scott Russell's advocacy of the through rail to India, he seemed to forget that the instance he named, of the present rail to Belgrade, to be probably ultimately extended to Constantinople, was not wholly designed at once, and, therefore, I take it that if the rail to India be desirable, there are excellent reasons for it being constructed in portions through the best routes as may be decided upon, and in time, possibly, the whole distance may be completed.

Then, too, I think Mr. Scott Russell appeared to lose sight of the great importance of the work on Imperial grounds.

I think it should also be well borne in mind that the Indian port to which this projected railway naturally points is Kurrachee, and that this is the port which, owing to the recent completion of the Indus Valley (State) Railway, is rapidly becoming the great landing place for the traffic to Scinde, the Punjab, and the North West Provinces, &c.

The general opinion of the meeting appeared to be quite in favour of the project, though some of the details might be somewhat altered from what Mr. Andrew sketched out in his most able paper; and he himself expressed his entire willingness to discuss such so soon as the primary conception be resolved to be carried into effect.

Frank Tayler, F.R.G.S.

156, Leadenhall-street, E.C.,
February 20th, 1880.

TRADE BETWEEN INDIA AND THE CHINESE DOMINIONS.

The supplement of the *Gazette* of India, dated November 8th, 1879, contains an interesting report on the Chinese tea trade with Tibet, by Mr. E. Colborne Baber, her Majesty's Consul at Chung-ching (or Chung-king, a town of Sz'chuen, at the confluence of the Fu with the Yangtsz River). He estimates the quantity of tea passing from Tachien-lu, in Sz'chuen, through Batang to Tibet, at ten million English pounds. The quality of the article is described as "the merest rubbish;" and it is further said that "the sweepings of Assam would make better tea than the Tibetans have ever drunk." Payment for this refuse tea is made at Tachien in the rupees of India, which are stated to have poured into Tibet so abundantly during the last fifteen years as to have become the currency of the country, a circumstance which may have had some influence on the silver question. The rupee is called "peiling-tchran-ka," or English coin, but the derivation of peiling is unknown to Mr. Baber. Peiling, or peling, is the Chinese form of Fering, Feringhi, or Frank, the well-known common name of Europeans in the East.

Whether Assam tea has already found its way into Tibet may be doubtful, as the trade in the Chinese article appears to be monopolised by the Lamas, who are reported by Mr. Baber to speculate largely in it, and store up considerable quantities in their Lamaseries. The circulation of Assam tea may, therefore, be obstructed by this means; and smuggling in opposition to a priesthood, who penetrate the inmost recesses of dwellings, would be attended with uncommon liability to exposure. But it seems not improbable that some among the Lamas themselves may be found disposed to take up the superior Assam tea as a means of competing with their brethren, who have greater advantages with the Chinese article. The demand for tea in Tibet is universal, while the supply is said to

be so inadequate that "a vast majority of Tibetans are unable to procure it, or at any rate enough of it."

Mr. Baber derives evidence of a very extensive trade between India and Tibet—extending as far east as Tachien-lu, in the province of Sz'chuen, in China proper—from the use of rupees, and of many articles of Indo-European origin. The facility of the trade is attested by the introduction into Tibet of such common articles as the tin platters of our cheap hardware shops, embossed on the edge with the Roman alphabet, and in the centre with a bust of the Prince of Wales or some other celebrity. These have become the dinner plates of the country, so far as any are used. British army buttons are very common, and the anna coin is imported from India to serve as a superior kind of button. Taking the presence of such articles as indicative of facility of transit, the great quantity of rupees is considered to prove the extent of the trade.

This commercial intercourse is said to cross the whole breadth of Tibet, and the absence of any British consul or diplomatic agent at Lhassa is much deprecated. A Nepalese officer is permitted to reside there, as the representative of the Ghoorka rajah, in accordance with the treaty of 1856, between the Ghoorka and Tibetan Governments. There is also said to be a representative of the Rajah of Jummoo at Lhassa.

Mr. Baber urges the inadequacy of temporary exploring or commercial missions for trading purposes, and he advises the negociation of a convention, coupled with the establishment of a permanent consulate at Lhassa, to counteract the adverse influence of the resident Chinese legates, and of the Lamas. He remarks that "the Tibetans, with their fondness for tea and their dislike of Chinamen, would be the first to welcome the best wares to the best market by the shortest road." As these observations emanate from a prominent member of the British Consular Service in China, stationed on the borders of Tibet, they may be regarded as a remarkable support of the advocacy of similar views by Indian officials. With reference to the friendly disposition of the Tibetan people towards the Indian Goverment, it should always be remembered that India is the Holy Land of their Buddhistic religious faith, and, as such, it must offer peculiar opportunities of conciliating them. The work of Dr. Rájendralála Mitra, on "Buddha Gaya," would, doubtless, be very acceptable to the Lama rulers in Tibet, Urga, and Pekin; and the attention which Buddhist remains are receiving from the British in India, Ceylon, and British Burma, and even in Afghanistan, would, doubtless, be viewed with satisfaction by the Lama priesthood. Lhassa is only about 200 miles from the Indo-Chinese frontier, or little more than half of the distance between Calcutta and Darjiling. Mr. Baber remarks that the distance between Lhassa and Calcutta is less than that between Paris and Berlin.

In drafting the convention, there is a danger of its scope being restricted by some limited object like Indian tea. Such was the fatal characteristic of the missions to the rebel Atalik Ghazi, which also fell under the objections expressed by Mr. Baber against proceedings of a temporary character. The trading connected with those missions was also attempted on the mistaken basis of selling to an impecunious people, instead of buying in a country abounding in raw produce, or capable of it, and so affording the settlers the means of becoming customers of manufactures in turn. The encouragement of that disintegration of the Chinese dominions has also proved to be a political blunder in more than one point of view, suffice it to say that while it served to open one hundred miles of frontier to our trade, for a short period, it was calculated to close more tightly, if possible, the remaining two thousand miles.

The proposed convention should not only embrace China and Tibet, but also the rest of the inland possessions of China, west of the 18 provinces, and Manchuria. It should provide for transit through Nepal, Sikkim, Botan, and the tribes eastward, so far as the Chinese and Tibetans are concerned, especially with regard to the passage of laden flocks employed in the delivery of wool and other raw produce along the whole line of the Himalayan basement. Wool is the great staple of the Chinese possessions conterminous with India, and stretching back to the Russo-Chinese frontier. By its export, the flock owners and people at large would be enriched, made peaceable and contented subjects of China, and friends of ourselves; for as sellers of the raw material they would soon become customers for the manufactured article, and thus while our British industries would be supplied with a new field for produce of unlimited amount, those industries would also find a new market for their manufactured goods at the same time. The sheep as a beast of burden, tested by our own officers, solves the whole question of mountain transit, and leaves it mainly to native discretion, supplemented only by such improvements as the native traders themselves may desire. Great engineering exploits, like the Dalhousie-road, are uncalled for, and a needless expense. It will be obvious, that in providing for an import of wool across the Indo-Chinese frontier for shipment or otherwise, that the export of tea and other Indian or European products into Tibet is commercially anticipated, and if the Chinese consent to the export of wool they will scarcely be in a position to resist any import that may be preferred by their own people in exchange, and thus the diplomatic arrangement for the admission of Indian tea will be at least facilitated.

Mr. Baber takes objection to the proposed opening of a direct route between Assam and Batang. The point is to connect Assam with the populous province of Sz'chuen, not merely on behalf of Indian tea, but in the general interests of commerce, which scarcely reaches that inland region from the Chinese seaboard, while it could not fail to spring up between these two inland provinces if political obstructions were removed. Those which may be fairly due to the mountain tribes would melt away, before the concurrent influence of the two empires.

The direct route between Assam and Sz'chuen passes from Sudiya in Assam through Ruima and Chusi, which are seats of Chinese and Lama officials. Whether Batang, or some point lower down the Kincha River, should be selected to enter Sz'chuen is indifferent, although Batang is admitted to be a town of great importance to the Chinese in communicating between Sz'chuen and Tibet. Our aim is to reach the heart of Sz'chuen. So far from desiring to reach Tibet from India by way of Batang, it is believed that the Chinese themselves would much more easily reach Lhassa through Assam, and that if the route were opened between Sz'chuen and Assam the Chinese would use it to reach Lhassa on account of its superior facilities.

With regard to intercourse between Assam and Yunnan, probably the route across the Patkoi Mountains and through Burmah, is deserving of attention, and the interest which Mr. Peal, of Assam, takes in that route, is likely to lead to its early examination.

A convention to remove obstructions to intercourse between India and the Chinese dominions is well calculated to cement the interests of the two empires, by opening up a new and abundant field for the development of the raw products required by the enlarging demands of growing populations, as well as a new market for manufactures.

Anglo-Indian.

NOTES ON BOOKS.

Sewage Disposal. By Henry Robinson, M.Inst.C.E. London: E. and F. N. Spon, 1880.

The author has confined himself in this book to the

consideration of such systems as he considers of the most importance. The information is condensed from data collected by Mr. Robinson "when advising sanitary authorities as to the best means of sewering their towns, and of purifying the sewage, or of otherwise disposing of it." Rivers' pollution (with reference to the Thames and the sewage of London), filtration, irrigation, chemical treatment, the Lime, Coventry, and A B C processes, sewage sludge, and the discharge of sewage into the sea, are subjects discussed in the various chapters.

Keramic Art of Japan. By George Ashdown Audsley and James Lord Bowes. Parts 1 to 7; folio. Liverpool, 1875-79.

This work, which forms two folio volumes, is now completed by the issue of the seventh part. It consists of an introductory essay upon Japanese art, illustrated by twelve photo-lithographic and autotype plates, and a dissertation on the keramic productions of Japan, illustrated by fifty-one coloured plates. The second volume ends with a list of marks and monograms.

The Magazine of Art. Vol. 2. London: Cassell, Petter, Galpin, & Co.

This volume, like the previous one, contains articles on the various subjects connected with the different fields of art, such as painting, sculpture, engraving, etching, china, and lace. Natural scenery, as the sketching ground of the artist, also is not forgotten.

Vere Foster's Public School Writing Copy Books. Nos. 1 to 10. London: Blackie & Son.

A series of books, commencing with strokes, easy letters, and short words, and ending with sentences, in which each word is written from beginning to end without lifting the pen.

GENERAL NOTES.

International Educational Congress.—It is proposed to hold a "Congrès International de l'Enseignement" at Brussels, in September of the present year, under the presidency of M. Vanhumbeéck, Minister of Public Instruction. There will be six sections, dealing with the following subjects:—1. Primary instruction, crèches, and kinder-gartens; 2. Middle education; 3. Higher education; 4. Special, professional, technical, agricultural, and commercial education; 5. Popular instruction—lectures, libraries, museums, and societies; 6. Scholastic hygiene.

Building Exhibition.—An Exhibition of Building Appliances and Manufactures is about to be held at the Agricultural-hall, Islington, from the 12th to the 17th of April. The collection will be divided into five sections, viz.:—1. Architecture; 2. Construction; 3. Engineering; 4. Decoration; 5. Furniture. The subdivisions will be arranged so as to include nearly every appliance of house building and furnishing, and many objects prepared for the Melbourne Exhibition are expected to be shown here before their despatch to Australia.

Millers' International Exhibition.—The first International Exhibition given under the auspices of the Millers' National Association (United States) will be opened at Cincinnati on May 31st, 1880, and continue open for two weeks. Premiums are offered in 11 classes, viz.:—1. Motive Power. 2. Steam Boiler and Engine Fittings. 3. Milling Machinery and Millers' Supplies. 4. Grain. 5. Products of the Mill. 6. Bread, Crackers, &c. 7. Baking Powder and Yeast. 8. Bags, Bagging, &c. 9. Scales. 10. Barrel Labels. 11. Miscellaneous, including a premium of 100 dollars for best paper-bag machine, and one of 100 dollars best cracker machinery.

Pittsburgh Glass Trade.—The glass manufacture of Pittsburgh, which is usually considered to be the iron metropolis of the United States, are growing in importance. There are in the town and neighbourhood 75 glassworks, of which 24 make table ware, 24 window glass, 8 fruit jars, 10 green and black glass bottles, 9 chimney glasses. The factories contain 700 pots, employ 5,550 people, and turn out a product valued at above six millions of dollars. By far the greater portion of this is for home consumption, the experts not, as yet, being on a very large scale, though they are steadily increasing:—

Year.	Value.	Year.	Value.
1870	530,654 dols.	1875	691,310 dols.
1871	466,447 „	1876	628,121 „
1872	547,112 „	1877	658,061 „
1873	627,562 „	1878	869,682 „
1874	631,827 „		

City and Guilds of London Institute.—A letter was recently addressed by Lord Selborne, F.R.S. (chairman of the Council), and Mr. F. J. Bramwell, F.R.S. (chairman of the Executive Committee), to the Prince of Wales, as president of her Majesty's Commissioners for the Exhibition of 1851, in which proposals were made for building a Central Institution or College for Advanced Technical Education, at a cost of £50,000 and upwards, on a plot of land fronting the Exhibition-road, South Kensington, and for maintaining the same fully fitted and equipped with all suitable appliances at an annual charge of at least £5,000 per annum over and above the amount of fees received. It is now announced that the Executive Committee of the Commissioners of 1851 are prepared to recommend the acceptance of these proposals made on behalf of the City and Guilds of London Institute.

THE LIBRARY.

The following works have been presented to the Library:—

Sanitas Sanitatum et omnia Sanitas. Vol. 1. By Richard Metcalfe, F.S.S. (London: Co-operative Printing Company, 1877.) Presented by the Author.

Notes on the Van Mine. By C. Le Neve Foster, B.A., D.Sc. (Reprinted from the Transactions of the Royal Geological Society of Cornwall.) Presented by the Author.

Description of the Machinery and Apparatus for a Gunpowder Factory. By James A. C. Hay, C.E. (Birmingham: Martin Billing, Son, and Co., 1877.) Presented by the Author.

Wood-working Machinery; its Rise, Progress, and Construction, with Hints on the Management of Sawmills, and the Economical Conversion of Timber. By M. Powis Ball, C.E. (London: Crosby Lockwood and Co., 1880.) Presented by the Publishers.

MEETINGS OF THE SOCIETY

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

March 3.—"The History of Musical Pitch." By Alexander J. Ellis, F.R.S. Dr. Pole, F.R.S., will preside.

March 10.—"Recent Advances in the Production of Lambeth Art Pottery." By John Sparkes. Sir Philip Cunliffe Owen, C.B., K.C.M.G., will preside.

March 17.—"The Art of the Silversmith." By W. Herbert Singer.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

April 14.—"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.

April 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"The Present Condition and Prospects of Agriculture in South India." By W. ROBERTSON, M.R C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MARCH 11.—"Balmain's Luminous Paint." By C. W. HEATON, F.C S. Professor H. C. ROSCOE, F.R.S., will preside.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S.

LECTURE V.—MARCH 1.

Ebonite or vulcanite. Its manufacture. Chemical and physical properties. Application in the useful and ornamental arts. Substitutes for India-rubber.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and ONE friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 1ST...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture V.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Prof. Pritchard, "Hereditary Diseases in Cart Horses."
Royal Institution, Albermarle-street, W., 3 p.m. 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. G. M. Ward, "The Utilisation of Coal Slack in the Manufacture of Coke for Smelting."
Royal United Service Institution, Whitehall-yard, S.W., 8½ p.m. Mr. B. B. Hotchkiss, "Hotchkiss' Revolving Guns."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Paper by Prof. Stokes, Sec. R.S.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. B. W. Richardson, "Health and Dress."
Medical and Chirurgical, 53, Berners-street, Oxford-street, S.W., 8½ p.m. Annual Meeting.

TUESDAY, MARCH 2ND...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture VIII.)
Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion on "Asphalte and Mineral Bitumen in Engineering Works." 2. Mr. H. E. Jones, "The Purification of Gas."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Mr. W. A. Forbes, "Contributions to the Anatomy of Passerine Birds." (Part I., "The Structure of the Stomach in certain genera of Tanagers.") 2. Messrs. Sclater and Salvin, "New Species of Birds from Eastern Ecuador." 3. Mr. Howard Saunders, "The Sea Birds collected by Lord Lindsay's Transit Expedition to Mauritius." 4. Mr. A. G. Butler, "New and little-known Butterflies from India."

WEDNESDAY, MARCH 3RD...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Alexander J. Ellis, "The History of Musical Pitch."
Entomological, 11, Chandos-street, W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Professor Redwood, "The Diffusive Properties of some Preparations of Iron." 2. Mr. Henry G. Greenish, "Note on Cantharides." 3. Mr. J. C. Thresh, "Volumetric Determination of Alkaloids."
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Dr. Phené, "Recent Excavations at Pergamos." 2. Mr. Jas. Stevens, "Romano-British Interment, Firgrove, Hants, recently discovered."
Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Croonian Lectures.) Dr. Cayley, "Some Points in the Pathology and Treatment of Typhoid Fever." (Lecture I.)

THURSDAY, MARCH 4TH...Royal, Burlington-house, W., 8½ p.m. Capt. Noble and Mr. F. A. Abel, "Fired Gunpowder. Note on the Existence of Potassium Hyposulphite in the Solid Residue of Fired Gunpowder."
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Dr. Gunther's postponed paper, "A Phosphorescent Organ in Fishes." 2. Mr. E. M. Holmes, "*Codilium gregarinum* (A. Braun) as a new British Alga." 3. Mr. J. Jenner Weir, "Abnormal Head of *Antilocapra americana*." 4. Dr. F. Day, "The Hebridal Argentine."
Chemical, Burlington-house, W., 8 p.m. Professor T. E. Thorpe, "The Relation between the Molecular Weight of a Body and its Specific Gravity when in the Liquid State."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. E. J. Watherston, "The History of Gems."
South London Photographic (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture VI.)
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. R. Harkness Twigg, "The Beneficial Action of Mind on Matter."
Archæological Institution, 16, New Burlington-street, W., 4 p.m.

FRIDAY, MARCH 5TH...Royal United Service Inst., Whitehall-yard, 3 p.m. Mr. Donald Currie, "The Adaptation of Ocean Steamers to War Purposes."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m. Mr. H. N. Moseley, "Deep Sea Dredging and Life in the Deep Sea."
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. A paper by Mr. Henry Sweet.
Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Croonian Lectures.) Dr. Cayley, "Some Points in the Pathology and Treatment of Typhoid Fever." (Lecture II.)

SATURDAY, MARCH 6TH...Royal Institution, Albemarle-street, W., 3 p.m. Mr. Saintsbury, "Dryden and his Period." (Lecture II.)

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FRIDAY, MARCH 5, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fifth lecture of the Second Course of Cantor Lectures, "On the Manufacture of India-rubber and Gutta-percha," was delivered by THOMAS BOLAS, F.C.S., on Monday, 1st instant. The Lecturer treated of ebonite or vulcanite, and substitutes for india-rubber. The next lecture, to be given on Monday next, the 8th inst., will be the last of the course, and will deal with gutta-percha. The Lectures will be printed in the *Journal* during the summer recess.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 3rd, 1880; WILLIAM POLE, Esq., Mus. D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bell, Major William Morrison, 40, Pall-mall, S.W.
Pierce, Josiah, 12, Beaufort-gardens, S.W.
Ross, David, B.A., Church of England Training College, Glasgow.

The following candidates were balloted for and duly elected members of the Society:—

Baker, Chas., 60, Francis-road, Edgbaston, Birmingham.
Heaton, Charles W., F.C.S., Charing-cross Hospital, W.C.
Hoe, C., 44, Leadenhall-street, E.C.
Mole, Frederic M., Granville-street, Birmingham.
Moon, Ernest Robert, 2, Temple-gardens, E.C.
Parkes, Sir Harry Smith, K.C.B., H.B.M. Minister, Japan, and Athenæum Club, S.W.
Plant, George William, 145, Queen Victoria-street, E.C.
Underhill, Arthur, M.D., Great Bridge, Tipton.

The paper read was—

ON THE HISTORY OF MUSICAL PITCH.

By Alexander J. Ellis, B.A., F.R.S., F.S.A.

Art. 1. *Introduction.*—On 22nd May, 1877, I read a paper in this room on "The Measurement and Settlement of Musical Pitch," for which the Society of Arts honoured me with one of their silver medals. Subsequently, it was objected that the instrument which I used for measuring pitch (Appunn's tonometer, see Art. 19) gave results differing considerably from those obtained by other observers, and was, therefore, probably incorrect. It was also objected that I had not given a sufficient account of early musical pitch. I have been able to discover the cause of the error of Appunn's instrument and its correction, and I have been fortunate enough to obtain a large amount of new information respecting early musical pitch. To arrive at these results has been a work of time, labour, and expense, far beyond what I could have anticipated, and I should never have obtained them at all without the co-operation of numerous friends and assistants, to whom I beg hereby to tender my most hearty thanks.[1] This must be my apology for the length of time that has elapsed between the reading of my first paper and its present correction and supplement.

Art. 2. *Pitch.*—By the pitch of a musical note I shall always mean, as is usual in England, "the number of double or complete vibrations, back-

[1] *List of my Principal Helpers.*—The following is a list of the principal public bodies and persons to whom I am indebted for assistance. Those to whose names a star * is prefixed have helped me very much indeed, several of them to an extent for which I cannot sufficiently thank them.

Public Bodies.—The Lords of the Committee of Council on Education, Science and Art Department; the Society of Arts.

Professors.—W. G. Adams, of King's-college, London; Cornu, of Paris; F. Guthrie, of the Science Schools, London; *Herbert McLeod, of Cooper's-hill College, Staines; *Alfred Mayer, of Stevens Institute, Hoboken, New Jersey, U.S.; Sir Herbert Oakley, of Edinburgh; Rev. Sir F. Gore A. Ouseley, Bart., of Oxford; *F. Rossetti, of Padua; Sir R. Stewart, of Dublin; J. Tyndall, of the Royal Institution.

Private Gentlemen and Ladies.—Herr Amels, formerly of Crefeld; R. Drew, Esq., of Dublin; Rev. G. T. Driffield, rector of Bow; Mr. George Herbert; M. Philbert, when Consul at Amsterdam; Rev. H. R. Haweis; Dr. Huggins, F.R.S.; *Frau Näke, of Dresden; the family of Scheibler, in Crefeld; Dr. W. Spottiswoode, P.R.S.; Dr. W. H. Stone.

Organ-builders.—Bevington, Bros.; Bishop and Son; Bryceson Bros., and Ellis; *A. Cavaillé-Coll, of Paris; Forster and Andrews, of Hull; Gray and Davison; *Hill and Son; Jehmlich, of Dresden; H. Jones; T. C. Lewis and Co.; Herrman Smith; Telford and Telford, of Dublin; Ullmann, of Vienna; J. Walker and Sons; H. Willis.

Pianoforte-makers.—Erard; *A. J. Hipkins, of Broadwood's; H. K. Moore, of Moore and Moore; Steinway; Streicher, of Vienna; Stuttaford, of Debain's.

Horn-makers.—Blaikley, of Boosey's; V. Mahillon, of Brussels.

Instrument-makers.—G. Appunn, of Hanau; W. Ladds.

Tuning-fork-makers.—Valantine and Carr, of 76, Milton-street, Sheffield; Secretan, of Paris.

Bell-founders.—Cavedini, of Verona; Colbacchini, of Padua.

Musician.—*Moritz Fürstenau, librarian of the Dresden Opera.

Violin-makers.—Hart and Son, Wardour-street; Hill and Son, Wardour-street; E. Withers, Wardour-street.

Organists.—E. Adams, St. Lawrence Jewry; Dr. Armes, Durham Cathedral; W. Bensted, All Hallows, Lombard-street; H. R. Brinfield, St. Lawrence, Reading; J. T. Burrowes, St. James, Piccadilly; H. Byolin, St. Mary, Shrewsbury; T. L. Childerstone, St. John, Clerkenwell; E. Deane, St. Mary, Aldermary; *H. Degenhardt, St. Catherine, Hamburg; Dr. G. Dixon, Grantham; Sir G. Elvey, St. George's Chapel, Windsor; J. G. B. Elliott, St. Stephen, Haggerstone; C. J. Frost, St. Mary, Haggerstone; Mrs. Green, St. Katharine, Regent's-park; F. Grizelle, Fulham; W. G. Hammond, St. Botolph, Aldgate; *E. J. Hopkins, Temple Church; A. W. Hume, Barking, Essex; J. Howlett, Trinity, Gosport; W. J. James, Shadwell; H. Jimmerthal, St. Marie Cathedral, Lübeck; W. C. Lock, St. Dunstan, Stepney; C. Marshall, St. Alban, Wood-street; Miss Nottingham, St. Mary, Rotherhithe; C. W. Pearce, St. Luke, Old-street; J. Ridgway, Holyrood Church, Southampton; *H. Schmahl, St. Jacobi, Hamburg; *Dr. Sellé, Hampton-court Palace; C. Severn, St. Mary, Islington; Dr. Stainer, St. Paul's; Mrs. Stirling, St. Andrew Undershaft; H. Stonex, Parish Church, Yarmouth; H. Streatfield, Maidstone; E. H. Thorne, St. Michael, Cornhill; Th. Sunbridge, St. George's Chapel, Great Yarmouth; J. Turle, Westminster-abbey; F. Weber, German Chapel Royal, St. James's; B. Yñiguez, Cathedral, Seville.——N. W. B. Collyer, Mercers'-hall Chapel; W. J. Ions, St. Nicholas, Newcastle-upon-Tyne; C. S. Jekyll, Chapel Royal, St. James's; R. Massey, late of Chapel Royal, Whitehall; F. I. Yeatman, All Hallows the Great and Less, Upper Thames-street.

Choir Conductors and 542 *Members of their Choirs.*—Henry Leslie, W. G. McNaught, J. Proudman, Ebenezer Prout, G. I. Venables, L. C. Venables.

wards and forwards, made in each second by a particle of air, while the note is heard." The words in inverted commas are briefly represented by the letter V. Thus, by V 256 is meant a musical sound due to 256 vibrations in a second. On the Continent, they usually reckon by *single* or half vibrations, as in counting a pendulum, written SV. Thus SV 512 means the same pitch as V 256. By V 256·3 is meant 2,563 double vibrations in 10 seconds, and so on for other decimals.

Art. 3. *Musical Pitch* is the pitch, or V of any named musical note, which determines the pitch of all the other notes in a particular system of tuning, and gives the pitch of the instrument producing it. For the sake of comparison, the same note A is here always selected, and, when it was necessary to determine the pitch by measuring the V of some other note, the V of A has been always calculated. By A 444 is meant the note called A, which makes V 444.

Art. 4. *Systems of Tuning, or Temperaments.*—For perfect harmony, the Fifths and major Thirds, in the treble at least, should produce no perceptible beats or roughness. This effect could not be obtained without many more than 12 notes to the Octave, the largest number used on ordinary organs, harmoniums, and pianos. Hence arose various contrivances, known as tunings, or temperaments (from the Italian *temperare*, to tune). In the history of pitch it is necessary to distinguish the following:—

1) *Just Intonation*, where all the Fifths and Thirds are perfect, used only by singers and theorists.

2) *Pythagorean Temperament*, in which the Fifths of the series, E *flat*, B *fl.*, F, C, G, D, A, E, B, F *sharp*, C *sh.*, G *sh.* only, are perfect, and the major Thirds E *fl.* G, B *fl.* D, FA, CE, GB, DF *sh.*, AC *sh.*, EG *sh.* only, are a comma, or V 1 in V 80 too sharp.

3) *Meantone Temperament*, in which all the major Thirds specified in (2) are perfect, but the Fifths specified in (2) are a quarter of a comma, or V 1 in V 322 too flat.

4) *Equal Temperament*, in which every Fifth, without exception, is one-eleventh of a comma, or V 1 in V 885 too flat, and every major Third, without exception, is seven-elevenths of a comma, or V 1 in V 126, too sharp.

These temperament will be distinguished by prefixing J for just, P for Pythagorean, M for meantone, and E for equal, to the name of the note calculated. The tuning note, which is measured, might be in any system, and hence is not distinguished. Thus, A 444 being measured, gives JC 532·8, PC 526·2, MC 531·2, and EC 528. In Table I., at the end of this paper, the JC, MC, and EC are calculated, corresponding to any A or other note that was measured, and the JA, MA, and EA corresponding to any C or other note that was measured.[2]

Just intonation is due to Ptolemy, the astronomer, A.D. 136. Meantone temperament was perfected by Salinas, A.D. 1577. Equal temperament is said to have been proposed by Aristoxenus, a pupil of Aristotle, and to have been in use in China for centuries earlier. It seems to have been used, in intention, in North Germany, as early as 1690, and to have remained on many organs. (See A 489·2 in Table I.) It was recommended by E. Bach, and is believed to have been used by J. S. Bach. But, throughout Europe generally, meantone temperament was used till about 50 years ago. It is still retained generally on Spanish organs, and in England on Green's organs, at St. George's Chapel, Windsor; St. Katharine's, Regent's-park; and Kew

[2] *Calculation of Temperaments.*—It is absolutely necessary, for all investigations on historical musical pitches, to be able to calculate A from C, and C from A, and sometimes from other notes, and often to find the V to all the notes in any system of temperament when the V of one is known.

To find C from A.

1) In Just Intonation, increase the V of A by one-fifth. Thus, to A 440, add one-fifth, or 88, to find JC 528.

2) In Meantone Temperament, first find JA, and then subtract 3 in 1,000 and 1 in 10,000, working to two places of decimals, and finally retaining one. Thus, from A 440, find JC 528, and then subtract 1·58 or 3 in 1,000, and also ·05 or 1 in 10,000; that is, 1·63 on the whole, giving 526·37, whence MC 526·4.

3) In Equal Temperament, first find JA, and then subtract 1 in 111. Thus, for A 440, we find JC 528, which, divided by 111, gives 4·76, and substracting this we obtain 523·24, whence EC 523·2.

To find A from C.

1) In Just Intonation, subtract one-sixth. Thus, one-sixth of JC 528 is 88, which, subtracted, gives JA 440.

2) In Meantone Temperament, find JA, and increase the result by 3 in 1,000 and 1 in 10,000. Thus, one-sixth of MC 526·4 is 87·73, which, subtracted, leaves 438·67, and this increased by 1·31, or 3 in 1,000, and ·04 or 1 in 10,000 gives 440·02, whence MA 440.

3) In Equal Temperament, find JA, and increase the result by 1 in 110. Thus, from C 523·24 we find JA 436·03, and, adding the 110th part, or 3·97, the result is EA 440.

A justly Intoned scale can be formed by adding one-eighth for the major Tones C to D, F to G, and A to B; one-ninth for the minor Tones D to E, and G to A; and one-fifteenth for the diatonic semitones E to F, and B to C.

A Pythagorean scale can be made from a series of Fifths up, adding one-half for each Fifth, and dividing by 2 when necessary to keep within the Octave; or a series of Fifths down, subtracting one-third for each Fifth, and doubling the result where necessary to keep within the Octave. Work up to G *sharp* and down to E *flat*, beginning anywhere.

A Meantone scale can be formed by taking the perfect Fifths, as in the last case, and then diminishing each upward and increasing each downward Fifth, as it is calculated, by 31 in 10,000. Thus, the perfect Fifth above C 256 is found by adding one-half, or 128, to be JG 384; taking 3 in 1,000, and 1 in 10,000, we have 1·19, which being subtracted, gives MG 382·81; and the perfect Fourth below C 256 is found, by subtracting one-third, or 85·33, to be JF 170·67, double which is 341·34; and then, taking 3 in 1,000 and 1 in 10,000, we have 1·06, adding which we have MF = 342·40. Begin anywhere, and work up to G *sharp* and down to E *flat*. Make two places of decimals and keep one.

A scale in Equal Temperament can be made by first forming a series of equal Tones by continually adding 12½ per cent., the proof being that the Sixth Tone thus found is scarcely more than double the first; then, the semitones may be found by adding 6 per cent., and subtracting 1 in 2,000 to each of the Tones. The result ought not to be wrong by one-tenth of a vibration anywhere.

The above are chiefly close approximations, very convenient for those who can use decimal fractions but do not understand logarithms. For those who do, the following table will be much more convenient.

To the logarithms given below, add the logarithm of the V of C, and the result is the logarithms of all the corresponding notes. When the V of any other note is given (as of E), subtract the logarithm opposite that note (as E) in the table from the logarithm of the V of the given note (as E.) The result is the logarithm of the corresponding V of C, having found which proceed as before. Find numbers corresponding to the logarithms to one place of decimals only.

Table of the Logarithms of Tempered Notes.

Note.	Just.	Meantone.	Equal	Pythagorean.
C	·0	·0	·0	.0
C *sharp.*		·01908	·02509	·02852
D	·05115	·04846	·05017	·05115
E *flat.*		·07783	·07526	·07379
E	·09691	·09691	·10034	·10231
F	·12494	·12629	·12543	·12494
F *sharp.*		·14537	·15051	·15376
G	·17609	·17474	·17560	·17609
G *sharp.*		·19382	·20069	·20461
A	·22185	·22320	·22577	·22724
B *flat.*		·25258	·25086	·24988
B	·27300	·27165	·27594	·27840
C *octave.*	·30103	·30103	·30103	·30103

Parish Church, and on a few other organs; but equal temperament is now generally aimed at, though seldom really attained.[3] Messrs. Broadwood did not use it on any of their pianos till 1840, and it was generally introduced in their works, under the superintendence of Mr. Hipkins, from 1844 to 1846. The organ of St. Nicholas, Newcastle-upon-Tyne, was tuned in equal temperament in 1842, on the occasion of a great musical festival (see A 428·7 in Table I.). In the Great Exhibition of 1851, no English organ was tuned in equal temperament. In July, 1852, while making alterations in the Exeter-hall organ, Messrs. J. W. Walker and Sons put it into equal temperament, and it was first used in that tuning in November, 1869. In the meantime, in September, 1852, Mr. George Herbert, a barrister and amateur, then in charge of the organ at the Roman Catholic Church in Farm-street, Berkeley-square, had that organ tuned equally by Hill, its builder. Though much opposed, it was visited and approved by many, and, among others, by Mr. Cooper, who had the organ in the hall of Christ's Hospital tuned equally in 1853. The first organ built and tuned originally in equal temperament, by Messrs. Gray and Davison, was for Dr. Fraser's Congregational Chapel at Blackburn, in 1854 (since burned). Messrs. Walker and Mr. Willis also sent out their first equally tempered organs in 1854. Hence, in England, equal temperament is barely 40 years old.

Before, and, indeed, after 1577, many unequal temperaments were used, and the meantone temperament itself is commonly called *unequal*, whereas, when expressed on 12 notes, it is merely defective, because it requires 27 notes to the Octave for its full development, as is shown in ordinary musical notation. The law followed in these unequal temperaments is generally so unknown that the exact values of the notes cannot be calculated. There was, however—at least, on the old bonded or fretted clavichord—a semi-meantone temperament, in which the natural notes C, D, E, F, G, A, B were tuned in meantone temperament, and the chromatics were interpolated at intervals of half a meantone. This was very like equal temperament in most keys. But, in the calculations of this paper, none but the Just, Meantone, and Equal systems of tuning will be regarded, and all the unequal temperaments, which were slight variations of the meantone system, will be treated as belonging to that species of tuning.

Art. 5. *Equal Semitones as a Measure of Relative Pitch.*—If we supposed that, between each pair of adjacent notes, forming an equal semitone as a piano is now intended to be toned, 99 other notes were interposed, making exactly an equal interval with each other, we should divide the octave into 1,200 equal hundredths of an equal semitone, or *cents* as they may be briefly called. We generally estimate intervals in music by the number of semitones they contain; thus, the minor Third has 3, the major Third 4, the Fourth 5, the Fifth 7 semitones, and so on. In the same way, very small intervals, less than a semitone, may be estimated in cents. Thus, S 3·56 means an interval of 3 semitones and 56 cents. In this way, in Table I. the interval formed by the initial value of A in each entry with A 370 is given.[4] The interval between any two such values of A is the difference of the corresponding S. Thus, the interval between A 455·3, S 3·59, and A 422·5, S 2·30, is S 1·29, which is the interval between Handel's and Erard's concert pitch.

Art. 6. *Notation of the Great Musical Scale.*—As the name of the note is the same in the different octaves, it is necessary to mark the Octave. I shall here adopt the organ-makers' names, by which an Octave is referred to a certain number of feet, and give it a practical notation. These names neither indicate the exact length of pipe nor the exact pitch of the note, but merely show its position on the musical staff.

32 C, lowest note of very large organs, 32 D, 32 E, 32 F, 32 G, 32 A (usual lowest note of the largest pianos), 32 B, comprising the 32-foot Octave, beginning 2 octaves below the lowest note of the violoncello.

16 C (lowest note of the double bass in Beethoven's Pastoral Symphony), 16 D, 16 E (lowest note of the German four-stringed double bass mentioned by Helmholtz, my translation, p. 267, as the lowest really musical note), 16 F (lowest note of English four-stringed double bass), 16 G (lowest note of Italian three-stringed double bass),

[3] *How to Tune Equally.*—In my translation of Helmholtz, p. 785, I gave a rule for tuning sensibly in equal temperament, and I put it into a thoroughly practical form in the *Musical Times* for 1st October, 1879, pp. 520—521. It may be epitomised thus. Tune the bearings in the one-foot Octave of an organ or harmonium in the order C, G, D, A, E, B, F *sh*, C *sh*., D *sh*., A *sh*., E *sh*. Make all the Fifths too close, and all the Fourths too wide, so as to beat the Fifths "up," CG, DA, EB, C *sh*. G *sh*., D *sh*. A *sh*., *twice* in a second, and the Fourths "down," GD, AE, BF *sh*., F *sh*. C *sh*., G *sh*. D *sh*., A *sh*. E *sh*., three times in a second. The Fourth CF is not tuned. The pitch is unimportant. The beats hardly last long enough to be available for the piano, which should be tuned to an harmonium.

[4] *To Calculate the Cents in any Interval.*—1) For intervals less than an equal semitone—that is, when the larger V is not more than 6 per cent. larger than the smaller V: Divide 100 times the difference of the V by 6 per cent. (less 1 per 2,000) of the smaller V to the nearest whole number. Thus, to find the interval between A 422·5 and A 440: 100 times the difference is 1,750, and 6 per cent. of 422·5 is 25·3, and this, less ·2 (or 1 per 2,000 in 422·5), is 25·1; then, dividing 1,750 by 25·1, we obtain 70 cents.

2) If the interval is more than an equal semitone, we can continually form equal Tones and semitones, above the lowest, by adding 12½ per cent. for a Tone, and 6 per cent. (less 1 per 2,000) for a semitone, till we obtain a V which is less than an equal semitone from the larger number. Then, we find the cents in this smaller interval by the last rule, and add 100 for each equal semitone added on to the lower V. Thus, for A 422·5 and A 455·3, we form an equal semitone above 422·5 by adding 25·1 (or 6 per cent., giving 25·3; less 1 per 2,000, that is, ·2, giving 447·6). Next, we find the cents in the interval V 447·6 to V 455·3 to be 29, as in the last case, and we have 129 cents. for the whole interval.

3) For intervals less than a just major Third—that is, when 8 times the larger V is not greater than 10 times the smaller V—multiply 3,477 by the difference of the V's, and divide by their sum. If the result lies between 150 and 300, subtract 1 from the quotient; the result is exact. Thus, for the last example, 3,477, multiplied by the difference 32·8, gives 114,045·6; and this, divided by the sum 877·8, gives 129 cents., as before. It is evident that this may be applied to any interval by continually reducing it by a just major Third till it is less than a major Third. This is effected by continually subtracting 10 times the smaller from 8 times the larger V, and adding 386⅔ cents. to the result, for every such reduction. When the interval exceeds an Octave, divide the larger V continually by 2 till it is less than double the smaller; then proceed as before, and add 1,200 to the result for each division by 2.

4) For any interval, by logarithms (by far the most convenient method for those who can use them), multiply the difference of the logarithms of the two V's by 4,000 (which will be enough for intervals under a semitone); correct by subtracting 1 in 300 and 1 in 1,000 from the former product. The result will be correct to one-tenth of a cent. Thus, log. 455·3 = 2·65830, log. 422·5 = 2·62583; difference = ·03247, which, multiplied by 4,000, gives 129·88. Subtract 1 in 300, or ·43, and 1 in 10,000, or ·01 (sum ·44), and the result is 129·44 cents, or 129 to the nearest cent. When many cases have to be calculated, it is best to form a little table of the multiples of 39·86314, and, by its means, multiply the difference of the logarithms by that number. This was the method pursued for Table I.

16 A (lowest note of English three-stringed double bass), 16 B, comprising the 16-foot Octave.

8 C (lowest note of the violoncello, written on the second leger line below the bass staff), 8 D, 8 E, 8 F, 8 G (third open string of violoncello), 8 A, 8 B, comprising the 8-foot Octave.

4 C (tenor C, the lowest note of the viola, written on the second space of the bass staff), 4 D (second open string of violoncello), 4 E, 4 F, 4 G (lowest note of the violin and of the English concertina), 4 A (first, or highest, open string of violoncello), 4 B, comprising the 4-foot octave.

2 C (middle C, written on the leger line between the bass and treble staves), 2 D (third open string of the violin), 2 E, 2 F, 2 G, 2 A (second open string of the violin, the *tuning note* for orchestras, and the note to which all pitch is referred in Table I.), 2 B, comprising the 2-foot Octave.

1 C (Treble C, a very usual tuning note for pianos, and pitching note for singers), 1 D, 1 E (first, or highest, open string of the violin), 1 F, 1 G, 1 A, 1 B, comprising the 1-foot Octave.

½ C, ½ D, ½ E, ½ F, ½ G (usual highest note of flute), ½ A, ½ B (highest note of the English concertina), comprising the ½-foot or 6-inch Octave.

¼ C, ¼ D, ¼ E (highest note on the violin, the double Octave harmonic of its highest string), ¼ F, ¼ G, ¼ A (usual highest note of large pianos), ¼ B, comprising the ¼-foot or 3-inch Octave. And so on for higher Octaves, used only on certain stops of organs.

Art. 7. *Carriers of Pitch.*—As very few persons are able to reproduce a pitch at will after the lapse of a short time, it is necessary to have instruments by which a given pitch-note may be sounded at any moment. The oldest of these contrivances are the metal cylindrical open flue *organ-pipe*, and the stopped *pitch-pipe*. In later times, the *tuning-fork* and the *free reed* have been used. In orchestras, the *oboe*, a reed pipe, is generally sounded for the other instruments to tune to.

Art. 8. *The Organ Pipe.*—The pitch rises with heat, and falls with cold, often making a semitone between its winter and summer pitches. When the V at any given temperature is known, the V at any other temperature may be found with sufficient exactness by increasing the first V by 4 per cent., dividing by 1,000 to 2 places of decimals, multiplying the result by the number of degrees Fahrenheit by which the observed differs from the required temperature, and adding or subtracting according as we reduce to a higher or a lower temperature. In this way all the organ pitches in table I., which I have myself observed, have been reduced to the pitch they would have at 59° F.= 15° C.= 12° R. Thus, A 528, at 59° F., gives what at 73° F.? To 528 add 4 per cent., or 21·12, which gives 549·12, and this, divided by 1,000 to 2 places of decimals, gives ·55, which, multiplied by 14 (the difference of 73° and 59°), gives 7·70, and, as the required temperature is greater, we have to add this 7·70 to 528, producing A 535·7 at 73° F. (See A 441·7 and A 443·1 in Table I.) As the wind used is often of a lower temperature to the air about the organ, and as the expansion of the air effects the temperature, the rule is not always perfectly accurate, but I have found it sufficiently so for the purposes of this paper. After touching an organ-pipe, or blowing it with the mouth, it should be left to cool before its pitch is taken. For the same temperature, the pitch is mainly influenced by the length of the pipe, measured from the line where it is soldered on to the foot, up to the open end, and by the internal diameter. If these dimensions are taken in inches, the pitch or V of the pipe is very nearly 20,080, divided by the sum of 3 times the length added to 5 times the diameter, according to M. Cavaillé-Coll (adapted from *Comptes Rendus*, 1860, p. 176), and in the two-foot Octave I have seldom found the result so much in error as a comma, or V 1 in V 80. If we actually find the V of a similar pipe, and multiply it by the sum of three times the length added to five times the diameter (expressed in inches), and use this product in place of 20,080, we may find the pitch of another pipe of the same kind, differing slightly in length and diameter, by dividing this product by the sum of three times the new length added to five times the new diameter, both taken in inches. I have had to use this device frequently when the actual dimensions of pipes made for me differed from their intended dimensions, in order, from the pitch of the actual pipe, to deduce that of the intended pipe. (See Table I., A 373·7, 376·6, 396·4, 424·4, 434·7, 446·0, 445·8, 504·2, 505·8[5])

The strength of the wind used is important. The above rule supposes this pressure to be capable of supporting a column of water about 3¼ inches high. From experiments made by M. Cavaillé-Coll, as pressure varies from 2¾ to 3¼ inches, V increases by about 1 in 300, but, as pressure varies from 3¼ to 4 inches, V increases only by about 1 in 440; the whole increase of pressure from 2¾ to 4 inches increases V by about 1 in 180. Hence the pitch of A may vary by from V 1 to V 2½ from this cause only. (See actual observations in Table I., under the pitches last cited.)

The quantity of wind, regulated by the size of the wind-slit and the orifice at the foot, is another source of variation. The shape of the mouth, and especially the shading of the mouth or extremity, greatly influences pitch. Hence a solitary pipe removed from the organ where it was shaded by adjacent pipes, is often sharper. Cleaning an organ sharpens it. Even removing a pipe and replacing it will often alter the pitch. An organ-pipe is slightly flattened by pressing in, and slightly sharpened by pressing out, the edges of its open end, as by the "tuning cone;" but considerable changes require the pipe to be lengthened or shortened.

It is clear, therefore, that, when the V of a pipe is not measured as it stands in the organ itself, the pitch given may be several vibrations in error.

[5] *M. Cavaillé-Coll's Rule.*—This rule requires to be a little changed for stopped and square pipes. For the square modern pipes the agreement is not quite so good as for the open metal cylindrical pipes, and a device similar to that in the text must always be employed for them. (See Table I. A 424·2.) In square pipes, the depth is from the mouth to the back, internal measure.

Complete Rule.—Pressure of wind about 3¼ inches or 8 centimetres. Divide 20,080 when the dimensions are in inches, and 510,000 when the dimensions are in millimetres, by—

(1) Three times the length added to five times the diameter for *cylindrical open* pipes.

(2) Six times the length added to ten times the diameter for *cylindrical stopped* pipes;

(3) Three times the length added to six times the *depth* for *square open* pipes; and

(4) Six times the length added to twelve times the *depth* for *square stopped* pipes.

The rule is always sufficient for cutting organ pipes to their approximate length, and piercing them to bring out the Octave harmonic.

And even where we are fortunate enough to find an organ with pipes that have remained unaltered for 200 or 300 years, which is seldom the case, we cannot be sure that it stands exactly at its original pitch. This must, of course, be borne in mind for all the cases of organ-pitch given in Table I. But the extreme amount of error will seldom be 1 per cent., which, for present purposes, is insignificant. In point of fact, the exact pitch of an organ cannot be ascertained, for it is so large that various parts of it are constantly at variable temperatures, and hence are constantly liable to be at different pitches, or out of tune with each other. Hence, in measuring the pitch of an organ, I always select the 2 A or 1 C of the open metal diapason, and, if possible, on the great organ, and consider that to be the pitch for which the organ was constructed.

Art. 9. *The Pitch-pipe* (of which I am able, through the kindness of the Bellfoundry Colbacchini, at Padua, to show you two very curious Italian examples of 150 and 100 years old, described under A 425·2 in Table I. below) is subject to all the errors of an organ-pipe, and being blown by the warm breath at very different pressures cannot be depended on for accuracy. But its portability, and the easy production of one or two Octaves of tone by sliding the piston in and out, formerly rendered it indispensable to singers who had no instrument to guide them. The same is true of pitch derived from flutes, clarinets, and oboes. (See remarks in Table I., under A 395·2, 410·0, 413·3, (2) A 418·0, 422·0, 425·2, 424·5.)

Art. 10. *The Tuning-fork*, originally called the *Pitch-fork*, was invented by John Shore, Royal Trumpeter, in 1711, Sergeant-Trumpeter at the entry of George I. in 1714, and Lutist to the Chapel Royal in 1715. He died deranged in 1753. Hence the tuning-fork is probably not more than 150 years old. It was very rude at first, as in this example, which was dug up at Brixton in 1878 (see A 454·2, in Table I.), but has, in late years, become a beautiful philosophical instrument, as in the larger forks before you. It is very permanent. I have reason to believe that Scheibler's forks have not varied by one vibration in ten seconds, since his death in 1837. It varies very slightly for temperature, being (contrariwise to the organ-pipe) flattened by heat and sharpened by cold to the amount of about V 1 in V 21,000 for each degree Fahrenheit. When, therefore, careful experiments have to be made, a tuning-fork should never be touched by the hand at all (wood or paper being interposed), or carried in the pocket, or struck hard or often (every blow heats, and, therefore, flattens it very slightly); but, for ordinary purposes, this is immaterial. As forks are tuned by filing, which not only heats them, but unsettles their molecular arrangements—at least, in part—it is necessary to let them cool and rest for several days, sometimes for weeks, before their pitch can be depended on for scientific accuracy. They will often rise by several vibrations in ten seconds in the course of cooling. Hence copies are always apt to be too sharp, and should, if possible, be re-compared. This has often caused me much difficulty, and, in several cases, a doubt will necessarily remain on such copies which have been sent to me. The difficulty of tuning a fork in exact unison with another is also extremely great. Hence, in Table I., such pitches may be too sharp by half a vibration in a second, or even more. We seldom find a batch of tuning-forks at the same pitch. (See A 435·4 in Table I.) On the whole, however, no more accurate means of preserving pitch exist. Two great sources of permanent injury to a fork are wrenching or twisting the prongs (as by a fall, or screwing the forks in and out of resonance-boxes, when the prongs ought never to be touched; or fixing both prongs in a vice to file) and rust. To preserve from rust, never stroke the prongs with the fingers (as musicians have a habit of doing), do not speak over the forks, keep them carefully from the damp (the large forks on resonance-boxes in chamois leather stalls, the smaller ones in cases, or folded in paper) and oil them occasionally with a film of limpid gun-lock oil (to be obtained from any gunsmith). If rust forms, prevent it spreading by applying oil, but be careful not to use sand-paper, as that will certainly injure the pitch still more. As most old forks are more or less rusty, it is important to have some notion of the amount of injury inflicted. Actual cases are investigated in Table I., under A 441·1, 441·8, and 443·2. But I found it advisable to try the following experiments:—Three ordinary forks, having been carefully measured, were immersed in water, one halfway from the end of the prongs, another halfway from the stem end, and a third totally. First experiment: they were left 48 hours in water, and then taken out without wiping and allowed to dry during 24 hours, they were then wiped and tried. Second experiment: afterwards, they were repeatedly immersed for a day or two, and taken out, being left to dry by themselves; this produced a large quantity of rust, which was rubbed off with soft paper, and then the forks were well oiled. The following were the results:—

Forks.	Original Pitches.	Pitches after immersion.	Alteration in V.	Alteration per cent. of V.
First Experiment—				
Prongs immersed	518·77	518·79	·0	·0
Bend immersed	528·20	527·90	— ·3	—·0566
Totally immersed	258·77	258·63	— ·14	—·0541
Second Experiment—				
Prongs immersed	518·77	518·44	— ·33	—·06
Bend immersed	528·20	526·30	—1·90	—·36
Totally immersed	258·77	257·72	—1·05	—·41

These experiments show that a slight amount of rust is imperceptible, and that with a very large amount, such as could not occur without the greatest carelessness, as in the old fork, described under A 454·2 in Table I., the error is never likely to exceed 4 in 1,000. For measuring pitch this would be fatal, but for merely conveying the history of a pitch it is perfectly unimportant. Observe that rust towards the extremity of the prongs is of slight importance, and, in case of complete rusting, almost the whole effect is due to rust at the bend. In all cases, the effect is to flatten the fork.

Art. 11. *The Reed.*—Harmonium reeds, placed in little tubes and blown by the mouth, may be classed with the pitch-pipes, convenient, but untrustworthy. The reed itself is apt to vary, and the pitch also depends greatly on the force of the wind. (See A 442·5 and A 488·0 in Table I.)

Art. 12. *Measurers of Pitch.*—The following are the principal methods for determining the V of any note heard:—1. By a string. 2. By the siren. 3. By Professor McLeod's optical method. 4. By Professor Mayer's electrographic method. 5. By beats.

Art. 13. *The String.*—A string, stretched by a constant weight, may be stopped at different places, and each sounding length will determine a different note, as on the violin. If the string were perfectly elastic and uniform, the V of these notes would be inversely proportional to the length of the string.

Assuming this to be always the case, Mersenne (1648) took a string long enough to allow its vibrations to be seen and counted, and then shortened it till it was in unison with a given note, and, after multiplying the observed V by the first length, divided it by the second (each expressed in the same unit), to find the V of the given note. He was, of course, very wrong, making an organ-pipe four French feet in length, speak, at one time, V 84, and at another, V 96, whereas, it probably spoke V 112. (See A 373·7, and A 376·6 in Table I).

J. H. Griesbach (1860) greatly improved on this method, by tuning a string, one-fifth of an inch (more accurately 5½ mm.) thick, till one-quarter of its length was in unison with a given note, and then counting the vibrations of the full length of the string (which was kept in action by a continuous bow) by making the string, as it reached its upper position, mark a strip of paper passed over it, on which seconds were also marked as they elapsed. The instrument itself is in Room Q of the Scientific Collection at the South Kensington Museum, with a description from the *Journal of the Society of Arts* for 6th April, 1860, p. 353. The extreme care with which Mr. Griesbach, worked, and, at the same time, the untrustworthiness of the arrangement, which is crowded with sources of error, is shown by some of his his results; thus, his V 416, V 521·6, and V 528, are shown, by re-measurement of the forks to be V 422·5, V 524·8, and V 534·46.

Euler and Bernouilli worked out the problem of the string mathematically,[6] but the difficulties of determining the unison, measuring the lengths, finding the weight, and obtaining uniformity in the string, together with those arising from its thickness, are so great, that the method cannot be relied upon for any great accuracy. We are, however, indebted to it for some important measurements by Euler, Dr. Robert Smith, Marpurg, Fischer, and De Prony. (See Table I., under A 392·2, 414·4, (2) 424·2, 427·6, (1) 431·7, 437·3, 438·2, (1) 441·7, (1) 444·5.)

[6] *Formula for finding pitch* from a heavy weighted suspended string. Let

L = the vibrating length of the string from the suspending point to the movable bridge, expressed very accurately in English inches.

l = the same in French millimètres.

W = the stretching weight of the string, including the weight of non-vibrating part of the string, expressed in any unit.

w = the weight of the vibrating length of the string in the same unit. These weights of the string are best obtained by stretching a similar string by the same weight and leaving it for some days till the stretching is complete, then cutting off a known length of it, weighing it, and dividing the whole weight of the string by the whole length to determine the weight of an inch or a millimètre of it. The weights are then found by measurement.

V = the number of double vibrations in a second. Then

$$2 \log V = 1{\cdot}98485 + \log W - (\log w + \log L)$$
$$= 3{\cdot}38968 + \log W - (\log w + \log l)$$

Delezenne, of Lille, made the best use of the stretched string. Having proved that only the finest wire which would bear the strain would give satisfactory results, he stretched 700 millimètres of such a wire on a violoncello body, tuned it to Marloye's fork of V 128 (which was, probably, very accurate, as Marloye's V 256 was so), and then, by a movable bridge, cut off the length, which gave a unison with a given fork. Measuring this length in millimètres, he divided 128 × 700 = 89,600 by it, to find the V. For organ-pipes, he first tuned a fork with sliders in unison with the pipe, and then measured the fork so tuned by his sonometer. (See Table I., under A 450·5.) I am indebted to Delezenne for numerous important pitches, which he believed to be correct within three-tenths of a comma, or about V 37 in V 10,000, and they are, very probably, still more accurate. He estimates that those who use Euler's formula may be wrong by a comma, or V 1 in V 80, or V 125 in V 10,000, owing to the mere thickness of the string necessary to support the stretching weight.

Art. 14. *The Siren* of Baron Cagnard de la Tour consists of a perforated disc, which is driven round by a stream of air, and, allowing puffs to pass through the oblique holes, makes a musical sound, of which the V is the number of such puffs in a second counted by an appended mechanism. M. Cavaillé-Coll added a bellows, giving a constant pressure of wind, and, by its assistance, he tells me that Lissajous determined the pitch of the French Diapason Normal. M. Cavaillé-Coll also improved the counting apparatus, by which he has been able to obtain even more accurate results. The ordinary siren of commerce is very untrustworthy; for example, Mr. Hullah's forks, thus measured, and intended to make V 512, really made V 524 3 to V 525 (See Table I., under A 441·3.) Even at the best, it is a difficult instrument to manipulate. Probably all the determinations of pitch made for the French Commission in 1859 were made by Lissajous and Despretz with this instrument, as well as those cited by de la Fage as made by Lissajous. These and other pitches determined by the ingenious inventor himself are all cited in Table I.

Art. 15. *The Optical Method*, invented by Prof. Herbert McLeod and Lieut. R. G. Clarke, R.E., and described in the "Proceedings of the Royal Society," for January, 1879 (vol. 28, p. 291), consists in viewing white lines, on a rotating cylinder, through the shadow of a constantly vibrating fork. The result is apparently, a dark wave, which remains stationary when the V of the fork is the same as the number of white lines which pass before the eye in a second. For effecting this, and counting the lines that pass, there are elaborate contrivances. The machine is very difficult to manipulate, but, probably, extremely accurate in result. It will be seen that I am greatly indebted to it for several measures of vital importance to my investigations.

Art 16. *The Electrographic Method* was invented by Professor A. Mayer, of Stevens Institute, Hoboken, New Jersey, U.S., who is preparing for publishing it in all its details. In this method, a camphor-smoked paper on a metallic rotating cylinder is inscribed with a wave-curve by an aluminium point fastened to one prong of a large

fork, through which a powerful induction coil, actuated by a seconds' pendulum, throws a spark, which burns a single hole in the paper precisely every two seconds. By counting the sinuosities in the wave-curve between these holes the V is determined. The difference of pressure of the aluminium point makes no difference in the rate of vibration. The flattening caused by the point is ascertained by beats. This instrument is, of course, expensive, and difficult to adjust, and is applicable only to large tuning-forks, the V of which it determines with great exactness. As will be seen, I have been greatly indebted to Professor Mayer for several measures of pitch taken by this instrument, but they could not be completed till 1st March, and hence must be communicated hereafter.

Art 17. *Musical Beats.*—When two musical notes of very nearly the same pitch are sounded together they produce beats, or loudnesses separated by silences, which, under ordinary circumstances, occur exactly as many times in a second as the V of one note exceeds the V of the other. The number of beats in a second can be counted easily when it lies between 2 and 5. Beyond 5 beats in a second there is considerable difficulty, arising from the rapidity of the loudnesses, and, after 6 beats in a second, the result cannot be depended on. Below 2 beats in a second there is also a difficulty, arising from the length of time occupied by each loudness. After 1 beat in a second the result can seldom be depended on. If, then, we know the exact interval between two notes, we can, by interposing forks and counting the beats, determine the exact V of each note. In particular, if the notes form an Octave, the beats in a second between them is the V of the lower note.[7]

Sauveur, 1713, used beats of organ-pipes (see A 406·6 in Table I.), and his experiments were successfully repeated by M. Cavaillé-Coll (Association Scientifique de France, Bulletin Heb., No. 81, 16 Aug., 1868, p. 126), but they were difficult and uncertain; and the organ-pipe varies too much with temperature to make it useful for measuring the pitches of other notes. Sarty (see A 436 in Table I.) complicated the matter more by using a monochord in addition, and his result is very uncertain. About 1865, Mr. Henry Willis, the well-known organ builder, also made a number of very careful experiments with organ-pipes, tuned by a slide on a slot, and actuated by bellows of constant pressure, of his own construction, with a view of determining difference of pitch by beats.

Art. 18. *Tuning-fork Tonometer.*—If two tuning-forks, making an Octave with each other, very nearly, but not exactly, be held over a resonance jar, tuned to the higher by pouring in water, beats are heard, and may be counted for from 10 to 20 seconds, between the precise Octave of the lower fork, and its approximate Octave, while the low note itself is practically inaudible. If, then, a number of tuning-forks be interposed between the two, beating roughly four times in a second, two and two, and, after having rested sufficiently for their pitches to become permanent, are accurately counted, the V of the lower fork, and hence that of all the intermediate forks, can be determined. For verification, it is best to carry the series to at least a dozen forks beyond the Octave. The forks should be good, beating at least 45 seconds audibly with each other, and furnished with wooden handles, but not screwed on to a resonance box. The difficulty is in counting with sufficient accuracy, for if the lower fork be about V 256, there will be 64 sets of beats to an Octave, and an error of ·01 beat per second, would make the serious error of V 0·64 in determining the pitch of the lower note.

The invention of this tonometer is due to Johann Heinrich Scheibler (born 11th November, 1777, died 20th November 1837), a silk manufacturer, of Crefeld, in Germany. His account of his method and mode of measurement, and the details of his tonometer of 52 forks, from A 219⅔ to A 439⅛, at 69° F., is given in his pamphlet, "The Physical and Musical Tonometer" (*Der Physikalische und Musikalische Tonmesser*, Essen bei Bädeker, 1834, pp. 80, and plates). His method was much more laborious than that here suggested, but his counting seems to have been wonderfully perfect. These 52 forks have disappeared since Scheibler's death, and all efforts I have made to discover them, with the help of Herr Amels and Scheibler's existing descendants (to whom I am much indebted) have hitherto failed. But a tonometer of 56 forks, which belonged, at least, to Scheibler, if it was not made by him, still exists, only there are no records of its having been counted by Scheibler. It was inherited by Scheibler's daughter, Madame M. E. L. de Greiff (died 4th September, 1854), and then by her son, Herr Aurel de Greiff, who gave it on a long loan to Herr Jean Amels, then of Crefeld, and now of 78, Newgate-street, London, silk merchant and musician, none of Scheibler's family caring for music. Herr Amels has kindly allowed me to have the use of this tonometer since 10th May, 1879, to the present time, and I am able to show it you this evening.

It was believed that this tonometer proceeded by 4 beats in a second, from 4 A 220 to 2 A 440. A very careful count showed me that only 32 out of the 55 sets of beats were 4 in a second, and that the others varied from 38 to 42 beats in 10 seconds. The best sum of all the beats that I could obtain was 219·27 in a second, which should, therefore, be the V in the lowest fork at 69° Fahr., the mean temperature used by Scheibler. It struck me then, as possible, that the extreme forks were really of the same pitch as those of the 52-fork tonometer, namely V 219·6⅔ and 439·3⅓. On that supposition, I had made the trifling error of V 0·4 in counting, and I distributed this among 20 of the 23 sets of beats, which were not exactly 4 in a second. Then I reduced the whole to 59° Fahr., and obtained the following result:—

[7] *Determining Pitch by Beats.*—Let the V of two notes be M and N, where M is greater than N, and let the ratio M and N be known, so that $n\,M = m\,N$. Let the sum of the beats in a second made by the interposed forks with the extreme notes and each other be b. Then $M - N = b$. These two equations give $(m - n)\,N = nb$, and $(m - n)\,M = mb$. If M is the Octave of N, then $m = 2$ and $n = 1$, and hence $N = b$. Suppose that we do not know the ratio $M : N$ exactly, but know that it is nearly that of $m : n$, and also whether M is too sharp or too flat, and have observed that the sum of the beats in a second of the forks interposed between M and N is c; then 1) if M is too sharp, we have $n\,M - m\,N = c$, and $M - N = b$, whence $(m - n)\,N = nb - c$, $(m - n)\,M = mb - c$; and 2) if M is too flat we have $m\,N - n\,M = c$ and $M - N = b$, whence $(m - n)\,M = mb + c$, $(m - n)\,N = nb + c$. The easiest and most important case is when M is nearly the Octave of N, and hence $m = 2$, $n = 1$. Then in the first case $M = 2\,b - c$, $N = b - c$, and in the second case $M = 2\,b + c$, $N = b + c$.

Scheibler's 56 Fork Tonometer at 59° Fahr.

No. of Fork.	Formerly presumed pitch.	Ellis's count.	Octaves of Ellis's.	No. of Fork.	Formerly presumed pitch.	Ellis's count.	Octaves of Ellis's.
1	440	439·54	879·08	29	328	327·62	655·24
2	436	435·74	871·48	30	324	323·61	647·22
3	432	431·84	863·68	31	320	319·54	639·08
4	428	427·96	855·92	32	316	315·54	631·08
5	424	423·96	847·92	33	312	311·54	623·08
6	420	419·96	839·92	34	308	307·54	615·08
7	416	415·74	831·48	35	304	303·61	607·22
8	412	411·74	823·48	36	300	299·39	598·78
9	408	407·74	815·48	37	296	295·57	591·14
10	404	403·77	807·54	38	292	291·70	583·40
11	400	399·76	799·52	39	288	287·70	575·40
12	396	395·79	791·58	40	284	283·70	567·40
13	392	391·67	783·34	41	280	279·69	559·38
14	388	387·57	775·14	42	276	275·69	551·38
15	384	383·57	767·14	43	272	271·69	543·38
16	380	379·60	759·20	44	268	267·77	535·54
17	376	375·60	751·20	45	264	263·82	527·64
18	372	371·68	743·76	46	260	259·81	519·62
19	368	367·56	735·12	47	256	255·64	511·28
20	364	363·63	727·26	48	252	251·67	503·34
21	360	359·63	719·26	49	248	247·67	495·34
22	356	355·63	711·26	50	244	243·67	487·34
23	352	351·63	703·26	51	240	239·66	479·32
24	348	347·63	695·26	52	236	235·69	471·38
25	344	343·62	687·24	53	232	231·69	463·38
26	340	339·62	679·24	54	228	227·77	455·54
27	336	335·62	671·24	55	224	223·77	447·54
28	332	331·62	663·24	56	220	219·77	439·54

The difficulty was now to verify my count, which had been made with great care with the help of a ship chronometer, each set of beats having been counted repeatedly for 40 seconds. But, then, I could not feel sure of being right in my count within V 0·05 or V 0·025 at most, and this left the distributed error of V 0·02 imperceptible. From this difficulty I was relieved by the kindness, first, of Prof. Herbert McLeod, and subsequently, of Prof. Alfred Mayer. Both counted for me by their instruments already described, five large French forks which I had had made, and Prof. McLeod also lent me four of Koenig's forks, which he had carefully measured. On measuring these by Scheibler's forks, using the values given in the preceding Table, I obtained results practically identical with those of Prof. McLeod, as shown in the following Table, in which all the V are reduced to 59° Fahr. The final results by Prof. Mayer have not reached me in time enough to insert in this place, but will be subsequently communicated to the Society.

Name of Fork.	Ellis.	McLeod.
1812, Conservatoire A.....	439·54	439·55
1820, Tuileries A.....	434·25	434·33
1818, Feydean A.....	423·09	423·02
1789, Versailles A.....	395·79	395·83
Nominally.		
Marloye Ut_3 256.....	255·96	255·98
Koenig Ut_3 256.....	256·30	256·31
,, Mi_3 320.....	320·30	320·37
,, Sol_3 384.....	384·43	384·44
,, Ut_4 512.....	512·55	512·55

The extreme closeness of these results gave me perfect confidence in using this 56-fork tonometer of Scheibler for all the measurements made for this paper. My rule has been to determine the beats several times (generally 5, often 10) with each of two forks, and to take the mean of all the results. It is, therefore, probable that measures of forks which I could count for 10 seconds, are not so much as V 0·1 in error.

Other tuning-fork tonometers have been made by Wölffel and Koenig, both of Paris, but I have had no opportunity of examining and comparing them. Koenig is reported to have lately invented a new and exceedingly accurate counting instrument, but I have seen no description of it as yet. The great difficulty in verifying is one of the disadvantages of the tuning-fork tonometer. I have found it impossible to verify by imperfect Fifths, as their beats last too short a time to be counted with any approach to sufficient accuracy.

By furnishing Messrs. Valantine and Carr, of 76, Milton-street, Sheffield, extensive tuning-fork makers to the music trade, with standards counted by means of this Scheibler's tonometer, as thus valued, I have enabled the public to obtain small forks, such as are usually employed for giving pitch, at moderate prices, and of great accuracy, that is, seldom or ever showing half a vibration in a second different from the number impressed on them. For those who wish to know the pitch of instruments or orchestras within the usual limits, I recommend pocket-boxes of 12 forks, either V 412 to V 456 for A or V 500 to V 544 for C. Such boxes, properly fitted, would cost, complete, about two guineas. Single forks above V 412 can be made for 3s., and below to V 256 for 4s. 6d. each. Larger forks are more expensive, 6-inch prongs costing 15s. It would be quite impossible to obtain such cheap forks elsewhere with anything like the same accuracy of pitch, and I consider it one of the principal results of my long and laborious countings that I am able to show investigators where they can obtain the tools they need. Messrs. Valantine and Carr also make complete Octaves of 65 forks at similar reasonable prices, and then the operator can count for himself; they have already made two such sets.

Art. 19. *Reed Tonometer.*—To remedy the deficient power of verification in the tuning-fork tonometer, and to accomplish many other desirable objects, Herr Georg Appunn, of Hanau, invented his tonometers of 65, 33, and 57 reeds, of which copies may be seen in the South Kensington Museum, and of the two first at the Museum of King's College, London. Lord Rayleigh has also a copy of the first. I have carefully examined all of these copies. I was so pleased with the first, after long work upon it without discovering error, that I used it in my former paper for measuring pitch, notwithstanding that it differed considerably in its indications from other measurements. The cause of error could not be discovered by long work and counting with a single instrument. It was not till the Lords of the Committee of Council on Education permitted me to remove the 65 and 33-reed tonometers to King's College Museum, that I discovered the curious fact on which it depended. The decisive observations were of this kind. Suppose L, M, N are three consecutive reeds on one instrument, and P, Q, R three reeds of the same pitch on another. (In point of fact, the instruments, which had been

made independently, were not exactly in unison, and this was the first shock that my belief in their accuracy sustained.) Then I beat L with M, and M with N, and adding the observed beats, I obtained what I term the "internal beats" of L with N, that is, such as take place inside the box containing the reeds. Next, I beat L with Q, and Q with N, and adding them, I obtained the "external beats" of L with N, that is, the beats made outside the box containing the reeds, in the free surrounding air. Now, the internal were always more than the external beats. My first experiment showed that the internal exceeded the internal beats by about 1 per cent. Continuing the experiments for many weeks, till all the beats were thus counted, and varying the experiment occasionally by sounding L and B at different ends of the Museum, at least 50 feet apart, while I stood midway to count, I found, as a mean of all my observations, that the number of internal beats must be reduced by $7\frac{1}{2}$ per 1,000 to produce the external beats, and that, consequently, the values obtained for the reeds, by counting internal beats, must be reduced in the same proportion. The internal beats were counted on the King's College copy. Last autumn I varied this experiment, by taking the pitch of each reed of all three tonometers in the South Kensington Museum, by beats with Scheibler's forks as counted above. The result was, that in order to reduce Appunn's numbers on the 65-reed tonometer (nominally V 256 to V 512) to Scheibler's, it was necessary, as a mean, to deduct 76 in 10,000, precisely confirming the former result (showing that the instrument went actually from V 254 to V 508). For the first Octave of the 57-reed tonometer (nominally V 64 to V 128), the same reductions was obtained (showing that instrument went really from V $63\frac{1}{2}$ to V 127). For the 33-reed tonometer (nominally V 128 to V 256), the reduction was 83 in 10,000 (showing that the instrument went really from V 127 to V $253\frac{3}{4}$); but, then, almost every reed of this tonometer (which had been sent from Germany afterwards, and without comparison) was flatter than its corresponding Octave in the 65-reed tonometer, and the Octave was not quite perfect.

What the cause of this "drawing" of the beats may be, has not yet been investigated. Its direction and amount was, I believe, entirely unknown previously, and hence Herr Appunn can hardly be blamed for overlooking it. Nor does it in any way detract from the use of the instrument. When the beats have been exactly counted, and hence the values of the reeds determined, we have only to reduce these values by 76 in 10,000, with the help of a little table (like that of Scheibler's forks given above), and the instrument is as useful as ever to determine pitch and make experiments. Thus Koenig's forks, when I take the numbers from Appunn given in my former paper, and reduce them properly, are very near what we may suppose Koenig's to have really been, as calculated from his Ut_3 = V 256·28, and supposed to be absolutely correct harmonics. Of course there were slight errors in my former measurements, which were early attempts, and frought with difficulty, and, possibly, either slight errors in Koenig's own excellent workmanship, or slight subsequent changes due to rough usage.

No. of Harmonic.	Marked values in simple Vibrations.	Calculated values in double Vibrations.	Measured by Appunn's Tonometer.	Reduced by substracting 76 per 10,000.	Difference from calculated values.	Harmonics of 64·105.
1	...	64·07	...	...		64·105
4	Ut_3 512	256·28	258·4	256·42	+ ·14	256·420
5	M_3 640	320·30	323·1	320·64	+ ·34	320·525
6	Sol_3 768	384·42	387·6	384·64	+ ·22	384·63
8	Ut_4 1024	512·56	516·7	512·75	+ ·19	512·84
10	M_4 1280	640·70	646·0	641·07	+ ·37	641·05
14	7. 1792	896·98	905·0	898·10	+ 1·12	897·47
16	Ut_5 2048	1025·12	1032·6	1024·7	− ·42	1024·68
18	Re_5 2304	1153·26	1163·3	1154·4	+ 1·14	1153·49
20	Mi_5 2560	1281·40	1292·0	1282·1	+ ·70	1282·1

By examining the harmonics in the last column, deduced from a quarter of 256·42, it will be seen that they agree closely with the reduced numbers in the fifth column except in two cases (those in which the apparent error in the sixth column exceeds 1), and this seems to point to a small error in measurement in these two cases. All the four last pitches had to be counted by high partial tones of the reeds, and hence mistakes were very probable. But this crucial test shows that the errors made neither arose from grossly erroneous counting, nor from careless manufacture of the reed tonometer, but must have proceeded, as my other observations establish, from an acoustical phenomenon affecting all the nominal values of the reeds in the same ratio. And this is my answer to the first objection raised against my former paper. At the same time, I feel that I owe an apology to Herr Koenig, for my having been unfortunately misled by the unknown error of Appunn's instrument to attribute that error to him, and I make this apology most sincerely, for no one deserves more thanks from acousticians than Herr Koenig, both for the excellence of his workmanship, and the ingenuity of his contrivances.

Besides this accoustical acceleration of the beats, there remain two other drawbacks to Appunn's tonometers: first, they do not retain their pitch with accuracy, and, secondly, their variation with temperature is unknown. Hence they are not, as I had hoped, instruments of scientific precision, though admirable for all purposes of lecture illustrations.

Art 20. *Practical Importance of Musical Pitch and its History.*—If two instruments, tuned to the same system, are not at the same pitch, they cannot be played together. Some instruments can be slightly altered to agree with others, but none to any great extent, and all instruments would be more or less injured in effect on being altered by a semitone, although this is the practice in Spain when instruments play with the organ. (See (2) A 419·6 in Table I.) All instruments have a limited compass, that is, they cannot produce any musical sound at all above or below a certain pitch, hence their power of transposition by a semitone or more is limited. This is most seriously felt by the human voice. If, for example, a piece of music, written for a very high pitch, is sung to a very low pitch, the lower notes will indicate depths which the voice cannot reach; this occurs in singing Orlando Gibbons's church music, which was written for a much higher pitch than we now use, and, consequently, has to be transposed to make it suit the present values which we give to the notes. (See

the conclusion of the remarks on A 567·3 in Table I.) More frequently, however, works written for a low pitch (such as Handel's A 422·5, or Mozart's A 421·6) have to be sung to a modern orchestral pitch, rather more than an equal semitone (actually S 1·27) higher. The voice of the singer, therefore, becomes distressed in reaching its upper limits, or has to give up the attempt altogether.

Now, it so happens, that a great deal of the best music was written to comparatively low pitches. This is not generally known. The notes bear no traces of it. It could only be surmised from them, as in the case of Handel, and then not with certainty. It becomes, then, of practical importance to know precisely for what pitch the principal musical composers wrote, and of antiquarian importance to trace the formation of that pitch, and its subsequent abandonment. This is what I endeavour to do in the following history.

Art 21. *Compass of the Human Voice.* — From the remarks just made, it will be readily seen that the importance of musical pitch consists in the nice adjustment of the work required from the voice to the work it is capable of performing. Hence, the first requisite to understanding the variations of pitch, or the value of any pitch proposed, is to know, in numbers of vibrations, the average limits of each kind of voice for which composers write, and on which instruments, by accompanying, impose an interpretation. It is clearly essential that no instrument should make a composer expect an impossible performance. Now, I was unable to find any satisfactory solution of this problem. The ranges of the several voices are given by Mr. Alberto Randegger, in his Primer on "Singing" (Novello, 1879), expressed in notes, which, as he kindly informed me, referred to Broadwood's medium pitch A 446·2, so that they can be immediately translated, assuming equal temperament, into numbers of vibrations. But, proceeding only by equal semitones, the intervals were too large, and although, doubtless, due to great experience, they did not seem to be founded on a sufficiently extensive observation of chorus singers; hence, I felt compelled to undertake the investigation myself. I am indebted to the great kindness and liberality of the choir conductors, Messrs. Henry Leslie, W. G. McNaught, J. Proudman, Ebenezer Prout, L. C. and G. I. Venables, and 542 members of the choirs they conduct, for having been able to try it upon a sufficiently large number of voices, to furnish a trustworthy mean. The Table in next column gives the numbers of each kind of voice examined, rejecting duplicates.

These numbers by no means represent the full numbers of the members of these choirs, but only the few who happened to be present on the practising nights that I attended, during very unfavourable weather. Thus, I attended Mr. Henry Leslie's choir during the dense fog of 27th January, when the room itself was full of fog, and the attendance was, consequently, extremely limited.

The method adopted was as follows:—I procured four forks, tuned to V 507, 522·5, 528, and 540·7, of which the three first represent the *just* C, corresponding to Handel's A 422·5, French Normal A 435·4, and Scheibler's A 440, and the last is Mr. Hipkins's fork, representing the highest Philharmonic pitch in 1874, giving EA 454·7, but JA 450·6. The first and last forks are a diatonic

Choirs in Order of Examination.	S	A	T	B	Totals.
1. Bow and Bromley Institute Choir; conductor, Mr. W. G. McNaught	22	20	23	29	94
2. Mr. Proudman's Voice-training Class, at the Tonic Sol-fa College Winter Classes	8	1	10	2	21
3. South London Choral Association, Advanced Choir; conductor, Mr. L. C. Venables	40	25	26	33	124
4. Tonic Sol-fa Choral Association, Select Choir; conductor, Mr. Joseph Proudman	20	11	10	12	53
5. South London Choral Association, Intermediate Choir; conductor, Mr. G. I. Venables	30	13	11	23	77
6. Borough of Hackney Choral Association; conductor, Mr. Ebenezer Prout	38	25	19	24	106
7. Mr. Henry Leslie's Choir; conductor, Mr. Henry Leslie	18	13	18	18	67
Total independent voices	176	108	117	141	542

semitone apart; the two middle ones are a little less than half that from each extreme. I had printed four descending scales marked *do, si, la, sol, fa, mi, re, do, si*$_1$, &c., in words or letters, and four ascending scales marked *do, re, mi, fa, sol, la, si, do*^{1}, in the same way. Then I asked the conductor to pitch the voices of the choir to *do* from the first fork, and the choir to sing the scale down twice, the first time marking, by scratching out, the lowest note to which each voice (after noting its own name) could sing *easily*, and the *extreme* lowest note it could sing at all, and at the second singing to revise its marks. Next, the voices took an ascending scale to the same pitch, and marked the highest *easy* note (male voices avoiding *falsetto*), and highest *extreme* note (admitting *falsetto*). The three other pitches were treated in the same way. As unaccompanied singers (especially the Tonic Sol-faists) naturally sing in just intonation, it was easy to calculate almost exactly the number of vibrations in each of the limiting notes. Then taking from the paper of each voice its easy and extreme limits, certainly found within a quarter of a tone, I was able, by adding the vibrations, and dividing by the number of voices, to get the average compass of each kind of voice, expressed in vibrations, and to compare them with Mr. Randegger's, expressed in the same way. The following Tables express the results obtained:—

The first Table gives the more important *easy*, lower and higher limiting notes of the compass of each kind of voice. The column headed *mean* gives, in name and number of vibrations, the mean note reached by the voices in the first column. The column headed *actual* gives the highest and lowest note actually sung, of all the notes from which the mean was calculated. In this column the letters H, F, S, P, refer to the pitches derived from Handel's, the French, Scheibler's, and the Philharmonic forks, all calculated in just intonation. The second Table gives the extreme limits in the same way, but these are not of so much importance, and in particular, the extreme higher limits of the bass and tenor, which include falsetto, are rather curiosities than otherwise. The third Table gives Randegger's regular and exceptional limits of the same voices, but, for comparison, the soprano and mezzo soprano are placed together, and the

tenor and barytone, instead of, as is more usual and natural, the mezzo soprano with the alto, and the barytone with the bass.

On the chart I exhibit, the whole results are written out in musical notation, in Broadwood's medium pitch, tailed white notes representing the means, and black notes with the tails turned different ways, the highest and lowest. In doing so, the notes were taken as named, except those marked H, which were taken half a tone flatter, thus HA is represented by A *flat*. On a piano, in concert pitch, no note will be then more than a quarter of a tone in error, and the table can easily be played. In the present paper, musical notation had to be avoided, for typographical reasons.

A strict comparison with Randegger will show great differences, for which probably good reasons can be given; and it should be borne in mind that Randegger's "exceptional," does not exactly correspond to my "extreme." The limits of this paper do not allow of a full discussion of these results, but reference will have to be made to them under A 503·7 and A 567·3, in Table I. below, for which the observations were mainly undertaken. In the meantime, observe that music for choruses should *not* be written for the average or mean limits, as probably one half the chorus could not reach those limits easily, and those that could would be distressed by them if they occurred frequently. But it is always safe to write from the actual highest form of the lower limit to the actual lowest form of the upper limit. Thus, it would not be safe to write for soprano choristers from the mean 4 F 180·2 to the mean 1 B 993·2, but it would be quite safe to write from the higher actual form of the lower limit, 4 PB 253·4, to the lower actual form of the upper limit, 1 SG 704. But even then, long frequent sustained and forte passages involving these notes would distress. Taken in the last-named form, the limits will be found to agree better with Randegger's.

Art 22. *Materials.*—Having learned how to measure pitch with tolerable ease and certainty, I began by collecting all forks with a name and a

Mean and Actual Compass of the Human Voice.

Voices observed.	Easy Lower Limit.		
	Mean.		Actual.
149 Sopranos	4 F	180·2	4 PB 253·4 to 4 PC 135·2
91 Altos	4 E *flat*	161·3	4 HA 211·3 to 4 SC 132
107 Tenors	8 G	98·2	4 FE 163·3 to 8 PD 76
125 Basses	8 E	81·2	8 HA 105·6 to 8 SC 66

Voices observed.	Easy Higher Limit.		
	Mean.		Actual.
145 Sopranos	1 B	993·2	½ SF 1408 to 1 SG 704
83 Altos	1 G *sharp*	835·7	½ PD 1216·4 to 1 PE 675·8
114 Tenors	1 C	520·8	1 PD 608·2 to 2 HE 316·9
120 Basses	2 F *sharp*	375·2	1 PC 540·7 to 2 FD 293·9

Voices observed.	Extreme Lower Limit.		
	Mean.		Actual.
173 Sopranos	4 E *flat*	161·9	4 PG 202·8 to 4 FC 130
108 Altos	4 D	147·1	4 SG 198 to 8 SB 123·8
114 Tenors	8 E	84·7	8 PB 126·7 to 8 SC 66
140 Basses	8 C *sharp*	71·6	8 PF 90·1 to 16 PA 56·3

Voices observed.	Extreme Higher Limit.		
	Mean.		Actual.
173 Sopranos	½ C *sharp*	1124·4	½ HA 1690 to 1 PG 811
105 Altos	1 B *flat*	951·6	½ SG 1584 to 1 PF 721
112 Tenors	1 D	616·9	1 PG 811 to 2 SG 396
139 Basses	2 B *flat*	482·9	½ PC 1081·4 to 2 SE 330

Randegger's Statement of Limiting Tones expressed in Number of Vibrations.

Regular.

Voice.	Lower Limit.		Upper Limit.	
Soprano	4 B *flat*	236·4	½ C	1061·2
Mezzo soprano	4 G	198·8	1 B *flat*	945·4
Alto	4 E	167·2	1 F	708·4
Tenor	4 C	132·6	2 B *flat*	472·7
Barytone	8 A *flat*	105·0	2 F	354·2
Bass	8 F	88·6	2 E *flat*	315·5

Exceptional.

Voice.	Lower Limit.		Upper Limit.	
Soprano	4 B *flat*	236·4	½ F	1416·8
Mezzo soprano	4 G	198·8	½ C	1061·2
Alto	4 E	167·2	1 G	795·0
Tenor	4 C	132·6	1 C *sharp*	562·2
Barytone	4 F	88·6	2 G	397·5
Bass	8 D	74·5	2 F	354·2

date to them, and others which, though impossible to fix to a certain place or date, yet represented a known note, and had, undoubtedly, considerable antiquity. The Society of Arts put their foreign forks at my disposal. Mr. Hipkins was most kind in allowing me to measure extremely valuable forks, and in procuring others for me. The Rev. G. T. Driffield allowed me to copy his Handel's fork. Frau Näke, of Dresden, sent over some very curious forks collected by her late husband. Prof. Rossetti, of Padua, procured me exact copies of interesting forks from Padua and Verona. Mr. Blaikley, of Boosey's, lent me a set of forks, formerly belonging to Prof. Faraday. Dr. W. H. Stone lent me others which had been tuned for him. I also procured copies of forks preserved in the Conservatoire at Paris, and had others tuned at known temperatures to remarkable organs in Vienna, Dresden, and Hamburg. These forks form the nucleus of my materials. But forks, as already mentioned, are only about a century and a half old, and it was necessary to go much further back than that, to meet the second objection raised against my former paper. Hence, I measured the pitch of numerous organs, which seemed to be untouched, and when organs failed, I was indebted to the kindness of organ builders for letting me measure the pitch of solitary pipes which they had preserved from organs they had rebuilt. Even these, however, often failed, and then I had recourse to measures of organ-pipes recorded in old books, as Schlick, 1511; Praetorius, 1619; Mersenne, 1636; Tomkins, 1668; Bédos, 1766, and others;[8] and from these and other measures Mr. Thomas Hill, of Messrs. Hill and Sons, kindly constructed pipes, which he not only allowed me to measure on his voicing machine, but most liberally presented to me. When even these failed, I had to trust to the memory of organ builders and organists as to certain organs being "flat" or "sharp," to which rather vague terms my researches enabled me to give a somewhat definite shape. This forms my own personal collection of materials. For the rest I had to trust to others, but I always endeavoured, at least, to trace their statements to the original source, and see how they obtained the pitch they give. In the first rank of these stands Scheibler himself, with about a dozen pitches, and the late Herr Näke, of Dresden, who used Scheibler's forks, and whose measures, where I could repeat them, were found very correct. Next comes Delezenne, whose method has been already explained, and whose work was excellent. Lissajous's results, believed to have been obtained with the siren and constant pressure bellows, stand, perhaps, next, but many of these are given only on the authority of de la Fage and others, and some are, perhaps, concealed in the report of the French Commission. The older determinations of Dr. Robert Smith (of Trinity College, Cambridge), Fischer (of Berlin), Euler, Marpurg, and Sauveur, were also examined.

From all these sources I have formed the large collection of pitches given in Table I., with every necessary particular respecting each, arranged by order of the pitch of A, and afterwards in Table II., by countries and places.

These two Tables, in fact, form my "history of musical pitch," but they require a little previous explanation to show their import and relations. Whenever, in future, I cite a pitch as A 505·8, reference should be made to that number in Table I., where all particulars respecting it will be found. This will save many repetitions. Table II. forms an index to Table I., as the pitch of A can be found by referring to the country, or place where it was used, and then by consulting Table I., all the other information I can furnish will be found.

The following condensation of these two Tables,

[8] *Titles of Old Books used as Authorities.—Schlick.* "Spiegel der Orgelmacher und Organisten, allen Stiften und Kirchen so Orgel halten oder machen lassen hochnützlich, durch den hochberümpten und künstreichen Meyster Arnolt Schlicken Pfalzgrauischen Organisten artlich verfasst." (Mirror of Organ-builders and Organists, very useful to all foundations and churches which possess or order organs, excellently composed by Master *Arnold Schlick*, Organist to the County Palatine.) Reprinted from the only known copy (belonging to Herr Wilh. Bethge, junior, and printed, apparently, by Peter Schöffer, in Mainz) in the "Monatshefte für Musik-Geschichte herausgegeben von der Gesellschaft für Musikforschung" (Monthly Journal for Musical History, edited by the Association for Musical Investigation.) First year, 1869, edited by Rob. Eitner, Berlin, pp. 78—114, with a *fac-simile* of the title, containing an engraving of an organist playing on the organ, with the bellows-blower behind it; in front, a performer on a rude clarinet, and two men and three boys singing from musical notes. There is no date to the book, but the Imperial Privilege to print is dated 3rd April, 1511. The second chapter "speaks of the dimensions of pipes, a good church measure, convenient to sing to, and for the organist to play," and the eighth chapter tells "how, and at what time, the organ should be tuned." This very interesting book, which was of great use in showing the relation between very high and very low church pitch, and the method of tuning before the invention of the mean-tone temperament, was lent to me by Mr. A. J. Hipkins.

Praetorius. "Syntagmatis Musici, Michaelis Praetorii C. Tomus Secundus de Organographia." (Second volume of the Musical Work of *Michael Praetorius C.*, concerning Organ description.) "Wherein" (translating the title) "the Nomenclature, Intonation, and Properties of all Musical Instruments, old and new, not only foreign, barbarian, rude, and unknown, but also domestic, artistic, lovely, and known instruments, together with an exact Figure and proper Counterfeit of the same; and also an exact description of Old and New Organs, Manual and Pedal Keyboards, bellows, specification and Stops, and also how to tune perfectly and easily the Regale and Clavicymbalum, and what has to be attended to in delivering over an organ, together with an appended copious index; not only very useful and necessary to Organists, Instrumentalists, Organ-builders, and Instrument-makers, and all who are devoted to music, but also very entertaining and elegant reading for Philosophers, Philologists, and Historians. To which is added a complete Index. Printed at Wolfenbüttel, at the house of Elias Holwein, printer and type-founder to the Prince of Brunswick. Published by the Author. Anno Christi, M.DC.XIX." Three small quarto volumes of this very rare and curious book exist, of which the above is the title of the second. Extracts from this book were first sent me by Herr Schmahl, Organist of St. James's Church (St. Jacobikirche), Hamburg, to whom I am much indebted for kind assistance. A complete copy (with the exception of one leaf of engravings), the only one, so far as I am aware, in the United Kingdom, exists in the Reid Music Library, attached to the Chair of Music in Edinburgh, and for six months' loan of this work, which has proved to be most essential to my investigations, I am indebted to the great kindness of the Professor of Music at Edinburgh, Sir Herbert Oakley.

Mersenne. "Harmonie Universelle, par Marin Mersenne, de l'Ordre des Minimes." Paris, 1636. Folio. In the British Museum.

Mersenne. Harmonicorum Libri xii., in quibus agitur de sonorum natura causis et effectibus: de Consonantiis, Dissonantiis, Rationibus, Generibus, Modis, Cantibus, Compositione, orbisque totins Harmonicis Instrumentis, authore F. M. Mersenno Minimo. 1648. In the British Museum and Library of the Royal Society. This is a Latin abridgment of the French book, from which it varies in part.

Tomkins. For the account of this book see under A 474·1 in Table I.

Bedos. "L'Art du Facteur d'Orgues, par Dom François Bédos de Celles, Bénédictin de la Congrégation de Saint Maur, dans l'Abbaye de Saint Denys, en France, de l'Académie." 1766. The finest and most complete work existing on the construction of the organ, of which J. G. Töpfer's work is principally an abridgment, with borrowed plates. In the Reading-room of the British Museum.

For temperament, also, I have had to consult—

Zarlino. "Le istitutioni harmoniche, del reverendo M. Gioseffe Zarlino di Chioggia." Venice, 1562. In the British Museum and Library of the Royal Society.

Salinas. Francisci Salinae Burgensis, abbatis Sancti Pancratii de Rocca Scalegna, in regno Napolitano et in Academia Salmanticensi Musicae Professoris, de Musica, libri septem. Salamanca, 1577. In the British Museum.

The titles of many other works which I have consulted are given sufficiently where they are cited.

in which the arrangement is by equal semitones, and tenths of equal semitones, from a lowest ideal pitch to the highest found, and also by the nearest whole number of the vibrations made by the single note A in one second, for a few of the principal and most characteristic pitches, with the designation of the classes into which I distribute them, will probably make it more easy to follow the remarks I have to make, while the filling up of details by Tables I. and II. themselves will give that feeling of confidence which can only arise from a most extensive induction.

Outline History of Musical Pitch.

S	A		
0·0	370	Ideal lowest, or zero-point.	Church Pitch lowest.
0·2	374	Hospice Comtesse, 1700.	
0·3	377	Schlick low, 1511; Bedos, 1766.	
1·0	392	Euler's Clavichord, 1739.	Church Pitch low.
1·1	395	R. Smith, 1759; Roman pitch pipes, 1720	
1·2	396	De Caus, 1615; Versailles Chapelle, 1789	
1·4	403	Mersenne Spinet, 1648.	Chamber Pitch low.
1·6	407	Sauveur, 1713.	
1·7	408	Mattheson, Hamburg, 1762.	
1·7	409	Pascal Taskin, court tuner, 1783.	
2·0	415	Dresden chained fork, 1722.	European Mean Pitch for two centuries.
2·2	420	Freiberg, 1714; Seville, 1785.	
2·3	422	Mozart, 1780.	
2·3	423	Handel. 1751.	
2·4	424	Praetorius's suitable pitch, 1619; original Philharmonic, 1813.	
2·5	428	R. Harris, 1696; Opéra Comique, 1823	
2·7	433	Sir George Smart's fork, 1820-26.	Compromise Pitch.
2·8	435	French Diapason Normal, 1859.	
3·0	440	Scheibler's Stuttgart Standard, 1834.	Modern Orchestral Pitch, and *Ancient Medium Church Pitch.
3·1	442	*Bernhardt Schmidt, low, 1690.	
3·2	445	Madrid, 1858; San Carlo, Naples, 1857.	
3·2	446	Broadwood's Medium, 1849; French Opera, 1856; Griesbach's A, 1860 =C 534; Griesbach's C 528, 1860.	
3·4	449		
3·5	451	Lille Opera, 1848; British and Belgian Army, 1879.	
3·5	453	Mean Philharmonic, 1846-54.	
3·6	455	Highest Philharmonic, 1874; Broadwood, Erard, and (English) Steinway, 1879.	
3·6	456	Vienna, high, 1859.	
3·7	457	(American) Steinway, 1879.	
3·8	458	Great Franciscan Organ, Vienna, 1640	Church Pitch high.
4·0	466		
4·3	474	Tomkins, 1668; B. Schmidt, high, 1683	
4·5	481	St. Catherine's, Hamburg, 1543.	
4·8	489	St. James's, Hamburg, 1688.	
5·0	494	St. James's, Hamburg, 1879.	Church Pitch highest.
5·1	496	Rendsburg, 1668.	
5·3	504	Schlick, high, 1511; Mersenne, ton de chapelle, 1636.	
5·4	506	Halberstadt Cathedral, 1361.	
6·0	523		
7·0	554		Chamber Pitch highest.
7·3	563	Mersenne, ton de chambre, 1636.	
7·4	567	Praetorius, North German, very old.	

Art. 23. *Early Church Pitch* (*Ton de Chapelle, Chorton*).—No doubt, the earliest musical instrument was the human voice, and the old lyres and flutes were merely arranged to steady it, and to give it such a pitch that its strains should not run beyond its compass. We have a notable instance of the latter use in the flute-player of Tiberius Gracchus, who always stood near him to give him the proper pitch of his voice. (Cicero de Oratore, lib. iii., §§ 225-228.) But with these ancient times I have nothing to do. I take up music at a point where the Pythagorean or Ptolemaic scale, or some of the numerous unequal temperaments, had been applied to church music for many years, and the pitches used can be compared with those now prevalent, because there was a practical agreement of notation and relative intonation. Also with those old instruments which were not intended to be played with any others, and which were consequently intoned simply in the way which was thought to bring out their quality of tone best, as Praetorius tells us, I have nothing to do.[9]

The pitch-pipe was the most natural instrument for starting the voice, and I have the impression that those primitive little organs, of which Prætorius speaks (*ib.*, vol. 2, p. 94), which were hung up against a column in the church, "like swallows' nests," as he says, and contained only the notes B *natural*, C, D, E, F, G, A B *natural*, C, D, E, F, or else the notes C, D, E, F, G, A, B *flat*, C, D, E, F, G, A, which have the appearance of a series of pitch-pipes, set to the proper notes, were really so, that is, were as much the development of the pitch-pipe, as the clavichord is well known to have been the development of the monochord. But to the pitch of these little instruments I have no clue.

I begin with the great organ of the cathedral of Halberstadt (29 miles S.W. of Magdeburg, in Prussian Saxony), finished on 23rd February, 1361 by Nicholas Faber, and restored, 1495, by Gregory Kleng, which was still existing, though no longer used, in the days of Praetorius, 1619, who has described and partly figured it. Praetorius gives the dimensions and name (B *natural*) of the largest pipe, from which I had a model constructed to a scale of one-sixteenth, which speaks four Octaves higher, and gives 4 B 284·5, whence J A 505·8, which sounds more like 1 C than 2 A. This is the sharpest pitch which I have measured, but not the sharpest which I have met with. It is nearly a whole tone sharper than the sharpest pitch now used in London. Practically belonging to nearly the same period, although, possibly, one or two centuries later, is the C of an ancient organ at L'Hospice Comtesse, near Lille, measured by Delezenne, and giving 4 C 112·7, whence A 374·2.

Now, these two pitches, A 374·2 and A 505·8, are S 5·22, or a comma more than an equal Fourth apart, and it requires considerable faith to believe that sounds so extremely different could ever have been conceived and written as the same note A. But a key to the mystery is furnished by Arnold Schlick, 1511, who says (chap. 2):—"The organ is to be suited to the choir [or church *chor*], and properly tuned for singing, for where this is not considered, persons are often forced to sing too high or too low, and the organist has to play the chromatics, which is, however, not convenient for

[9] *Ancient Pitch of Solo Instruments.*—"In the first place, it must be known that the pitch, both of organs and other musical instruments, varies greatly. Since the ancients were not accustomed to play in concert with all kinds of instruments at the same time, wind instruments were very differently made and intoned by instrument makers, some high and some low. For the higher an instrument is intoned in its own kind and manner, as trumpets, shawms, and treble viols, the more freshly they sound and resound. On the contrary, the deeper trombones, bassoons, bassanelli, bombards, and bass viols are tuned, the more majestic and magnificent is their stately march. Hence when the organs, positives, clavicymbals, and other wind instruments do not stand in the same pitch with each other, the musician is much plagued."—Praetorius, "Syntagma," vol. 2, p. 14.

everyone. But what is the proper length of the pipes for this purpose, and convenient to the choir to sing to, cannot be exactly defined, because people sing higher or lower in one place than in another, according as they have small or great voices. However, if the longest pipe, the F below the Gamma-ut in the pedal [that is 8 F below 8 G, the Gamma-ut being the name given by Guido Aretino to 8 G, the note on the last line of the bass staff], has its body down to the [beginning of the] foot, sixteen times the length of the annexed line [which the editors say is 4 and 7-8 Rhenish inches = 127·5 mm. long, so that the full pipe is 6½ Rhenish feet, or 2,040 mm. long], I think it will be a suitable length for the choir. But if you build an organ a Fifth larger, then you must make C in the pedal [that is, 8 C, the lowest note of the violoncello], of this length. . . . The reason is that a greater part of church music ends in *grambus* [a word which puzzles Schlick's editor, who says, however, that it can only mean the transposition of the *tonus primus* by a Fourth], than in the first tone." And he proceeds to show its advantage, and especially the advantage of the first pitch (with 6½ Rhenish feet to 8 F) in other ecclesiastical tones. Assuming that when Schlick's pipe was taken two Octaves higher, its diameter would be one-thirteenth of its length, which is not improbable, although, perhaps, it is rather narrow, I had such a pipe made, and then measured it, and found its pitch to be V 301·6. If we assume this as 2 F, and, taking 2 A a perfect major Third above (and Schlick's directions for turning made this major Third very nearly perfect), we obtain as the pitch A 377, which is practically the same low pitch as Delezenne's Hospice Comtesse A 374·2. But if, as in Schlick's greater organ, we assume the 6½ Rhenish feet for 8 C, we obtain A 504·2, which is practically identical with the Halberstadt A 505·8, and is parallelled by the actually existing organ of St. James's Church (*S. Jacobikirche*), at Hamburg, A 494·5, as now tuned, but formerly A 489·2. Hence, we have both the very sharp and the very flat pitch recommended by the same writer, at the same date, and on the same grounds, namely, the accommodation of the singer and the organist in playing the old ecclesiastical tones.

This gives the first three principles which seem to have determined early pitch, namely (1) ecclesiastical music, (2) ease of fingering it, (3) the compass of the human voice. To this we must add a fourth, and very important principle, which seems to have had great influence in practical construction, namely (4) the foot-rule of the country. It is clear that organ builders would naturally choose for their chief standard pipe some easy multiple or sub-multiple of the foot-rule with which they worked, as they could not well make their men attend to any other. The old organ builders divided the pipes into Octaves of so many feet each. I have adopted this division as the most generally received nomenclature of the great scale, for it is found, not only all over England, but also all over Germany, France, and Italy, despite the variety in the length of their feet. Although it has long ceased to be anything but a name, and does not at all signify the real dimensions of the pipes, being as much a survival as our own English spelling, it must, like that spelling, have had an original foundation in fact; and in Dom Bédos's great work on the organ, 1766, we find this division a reality, the 4 foot C being really a pipe of 4 old French feet in length, and so on. Now, for the same "scale" (that is, the same ratio between the diameter and length of the pipe), the pitch varies inversely as the length of the pipe, and much of the older diversity of pitch seems to me referable to the old diversity of measures. The following are the principal foot measures which have to be considered, expressed in millimètres to the nearest unit (25·4 mm., being one English inch):—

	m m.
Long old French foot, or *pied de roi*	325
Long German, or Rhenish foot	314
Long Austrian foot	316
English foot	305
Old Nurnberg foot	304
Old Roman foot (medieval).....	295
Old Augsburg foot	296
Bavarian foot.....	292
Short Saxon foot	283
Short Brunswick and Frankfort foot....	285
Short Hamburg and Danish foot	286
Very short old Brabant foot of 11 inches	278
13 Rhenish inches	340
13 Saxon inches.....	307
12 old Brabant inches	303

Now, a difference of 12 per cent. in the lengths of two pipes will, for the same scale, make a difference of nearly a whole meantone in their pitch. Thus the short Saxon foot was a meantone sharper than the long Austrian or Rhenish foot.

Again, 6 per cent. corresponds to an equal semitone, 3 per cent. to an equal quartertone, 5¾ per cent. to a semi-meantone, 4½ per cent. to a small, and 7 per cent. to a great, meantone semitone. Thus we see that the English foot is nearly a great semitone sharper than the French foot, and the Rhenish foot is about a small semitone sharper than the French, and the English about an equal quarter of a tone sharper than the Rhenish. Throughout Germany, there was a great variety of small feet, quite sufficient to account for a great variety of organ pitch.

The flat pitch took the most root in France. Dom Bédos says that chapel pitch was constant, and he draws and describes his pipes, proceeding by French feet, giving A 376·6, which is 2½ equal semitones flatter than the French diapason normal of 1859. The Rev. Sir F. A. Gore Ouseley, who has examined a large number of the continental organs, informs me that "most of the old *untouched* organs in the French cathedrals are of this low pitch" (see A 376·6). The English foot is a semitone sharper than the French, and the only English example of an organ in which C is 1, 2, 4, &c. feet, is that furnished by Trinity College organ in 1759, A 395·2, which is nearly three-quarters of an equal semitone sharper than Dom Bédos's A 376·6. In Germany, the low pitches I have found are few, Schlick's A 377, already noticed, and Solomon de Caus's A 394·4, which is sharper than the French, because the Rhenish foot itself is a quarter of a tone sharper.

On the other hand, the sharp organs are principally German, the Halberstadt A 505·8, Schlick's high A 504·2, and the existing pitches of the organ in the cathedral at Lübeck A 484·1, and the Hamburg churches of St. Catherine A 480·8, and

St. Jacobi A 494·5. In England, we had Tomkins's high pitch A 474·1, realised in Bernhardt Schmidt's old Durham organ, 1683, arising from placing the pipe, of one English foot in length, on A, which evidently belongs to this series. In France, Mersenne places the French four-foot pipe on 8 G for the *ton de chapelle*, giving A 503·7, agreeing with the Halberstadt. In Italy I found, preserved at the University of Padua, a 1 G made for Prof. Stratico, which would imply A 483·7, but whether it represented a pitch really used I do not know. The above high and low pitches seem to me to belong to this earliest period of church pitch; the other low and high pitches appear to have been influenced by other considerations, after the tradition of the older pitch had died out.

Art. 24. *Early Chamber-pitch* (*Ton de Chambre, Cammerton*).—Music was by no means all ecclesiastical. When choirs were formed for the church, and musical instruments were introduced to play with the organ, forming the German *Kapelle* (properly "chapel," but afterwards merely "band"), both choir and instruments were used by the king or prince to perform in his "chamber," that is, his private apartments, for his private gratification. But the music they wanted to play and sing far exceeded church requirements, and hence the old church pitch hampered them; it was generally either too high or too low. But as one set of instruments was wanted both in the church and the chamber—I have only heard of one place, Dresden, in which two sets of instruments were used (see A 424·0, and 437·8)—it was necessary that the chamber pitch should bear a definite relation to the church pitch; in other words, that it should differ from it by an interval of the scale. For this reason, apparently, chamber pitch differed from church pitch by a semitone, a Tone, or a minor Third, or even a Fourth, according to the pleasure of the performers. Dom Bédos says (Art. 1,140), that church pitch in France was fixed, but that the opera pitch (an advance on the chamber pitch) is not fixed, but ascends, or descends, a quarter of a Tone, or even more, according to the compass of voice. This, as well as the instruments which happened to exist in any place, had doubtless much to do with the great variety and confusion of the chamber pitch. It seems that, as a rule, this pitch tended towards a certain mean, by being a tone higher than the low pitches, and a minor Third, or even a Fourth lower, than the very high pitches. This, however, was not always the case. Mersenne's high church pitch is capped by his still higher chamber pitch, A 563·1, produced by putting the 4 (French) foot pipe on to 8 F. To modern ears, it would amount to transposing the bass by a Fifth, to allow it to be sung by a tenor, but it was evidently not so considered by Mersenne. We find, probably, as high a pitch called chamber pitch, by Praetorius. (See A 567·3.) Of course, we have very few direct traces of ancient chamber pitch. But the fact that St. Jacobi organ at Hamburg (formerly A 489·2 now 494·5), had for many years one stop, which was a minor Third flatter than the rest of the organ, that is, a little lower than the old pitch of the Dresden organ, A 415, and that this stop (long since replaced as useless) was said to be in chamber pitch, serves to show an indirect action of chamber upon church pitch. This stop evidently enabled the organist to play with the instruments occasionally without transposition. At present the organists of St. Jacobi and St. Catherine, at Hamburg, have always to transpose a tone or a semitone at sight, a state of things that certainly was not contemplated when their church pitch was settled.

Art 25. *Influence of Chamber-pitch on Church-pitch*.—The direct effect of chamber on church pitch was evidently the building of organs in chamber pitch, or the returning of old organs in that sense. This came to placing the standard lengths of pipe upon different notes, or shifting the existing pipes into different holes, so as to be actuated by keys a Tone or a Semitone different from those by which they were before evoked, and then supplying the required extra pipes, and trimming the old pipes for temperament. We have some conspicuous examples of this shifting, which is a very common device of organ builders at the present day. Thus the pitch of Trinity College organ was altered from A 441·7 to A 395·7, by shifting in such a way that the C pipe was made to speak to a D finger-key. The organs of the Temple and St. Paul's were altered from A 441·7 by shifting a semitone and then piecing when required to bring them probably to Sir George Smart's pitch A 433·2, which is practically identical with the modern French pitch. But, the flattening of St. Paul's proving disagreeable, after some years the pipes were shifted back again and retrimmed, so that the original pitch was restored. The present organ is new, by Willis, but is almost exactly in the first pitch (see A 444·7). The pitch of Durham Cathedral and St. James's Chapel Royal organs were altered in the same way (see A 474·1). It is evident that in such changes the traditions of church pitch were set at naught.

The changes of course differed in different countries. In France, to give the one foot French pipe to B *natural* produced A 395·8, which we find in the chapel of Versailles, and which is practically identical with putting the one foot pipe upon C at Trinity College, where B *flat* became C, producing A 395·2. I have no other certain indications of such a proceeding in France, because all the organs which Delezenne examined, except that of the Hospice Comtesse, which was in the oldest flat pitch, A 374·2, had been more or less repaired. The St. Sauveur, Lille, A 384·6, looks merely to be the old pitch with the pipes cleaned and "trimmed;" La Madeleine, Lille, A 398·7, seems, however, to be a similar alteration of an organ with the French foot on B. Mersenne's spinet, A 402·9, had its lowest note, 8 B, tuned to the 4-foot pipe. The V 7·1 difference between this and the Versailles A 395·8, may be merely a matter of temperature or scale. Let us briefly class these organs as French C foot and French B foot organs.

In England, we have this formation very marked. The old English A foot organ, A 474·1, belonged to the old sharpest organs, such as Tomkins's and Bernhardt Schmidt's high pitch at Durham, and at the old Chapel Royal, St. James's. The B *flat* foot organ, a great semitone lower, gave Bernhardt Schmidt's low pitch A 441·7, which, with a change of temperament, seems to be the favourite church-pitch among London organ-builders at this day. (See Gray and Davison's

A 440, Walker's 440·2, Bevington's A 440·5, Lewis' A 441, Hill's 441·7, Bryceson's 443·4, Willis's church-pitch, A 445·2.) The B foot organ, which, for 200 years, found the most favour in England, had two distinct forms: the *wide scale*, deduced immediately from Bernhard Schmidt's, and giving Green's A 422·6 or A 423·2; and the *narrow scale*, used by Renatus Harris, giving A 427·7 or 427·2, 434·7, or even A 419, according to pressure, &c. The C foot organ never seems to have found favour with us, although it is possible that Bernhardt Schmidt built some chamber organs at that pitch. (See A 395·2.) The alteration of the Trinity College organ to this pitch is attributed, by Dr. R. Smith, to the influence of Roman pitch. I have not been able to find a Roman pitch so low. The lowest Italian pitch, A 403·9, derived from an old Paduan fork, is, however, only S 0·38, or about one-sixth of a tone sharper. Euler's clavichord or spinet, A 392·2, seems to have been a Russian C foot instrument (the Russian foot agreeing with the English). But from this may have been derived Euler's organ, A 418, a semitone higher; that is, as nearly as I can judge from Euler's rather vague description. Again, in England, if from a B foot organ, giving A 424·6, we form an organ a whole great semitone sharper—that is, having its A on the B *flat* of the other organ, or its B on the C of that organ—we shall get A 454·2, a pitch which I found on a very old fork accidentally dug up at Brixton. This seems, also, to be the meaning of A 457·6, the pitch of the existing large organ in the Franciscan Church at Vienna. The natural alteration of an organ was by a great semitone, B *natural* to C; the small semitone, B *flat* to B, would only arise from shifting the pipes. It must be remembered that B *flat* was the only chromatic which formed part of the original musical scale. For a table of the relations of these organs, see the end of the remarks on A 474·1.

Art. 26. *The Mean Pitch.*—The result of all these different endeavours to reconcile the requirements of the church with those of the chamber seems to have been the institution of a mean pitch, which, within very narrow limits, prevailed for a very long time over most of Europe. This was, in fact, the chamber pitch, formed by taking the D of the old flat church pitch as C, and the A (or occasionally the G) of the high church pitch also as C. It was, therefore, a whole Tone above the flattest, and a minor Third (or occasionally a Fourth) below the highest pitches. This, at least, appears to me the origin of a pitch which certainly bears these relations to the older pitches, and was very widely used. In my list of Historical pitches, in Table I., 63 pitches lie between A 415, and A 430, the mean of which, A 422·5, is the exact pitch of Handel's fork, now in the possession of the Rev. G. T. Driffield, the Rector of Bow. This pitch I regard as the mean pitch of Europe during the 17th, 18th, and the early part of the 19th centuries, so important for musical art. The earliest recommendation of this pitch I find in Praetorius, 1619, in an N.B. at the end of his second volume, p. 231, where he says:

"In this second volume I have often had to speak of the true Church pitch (*des rechten Chor-Tons*). I have found that, in many places, even in large and important cities, and on their splendid organs, the proper Church pitch, by which both human voices and instruments must be regulated, was not used, but their pitch was either too high or too low, forming one of the principal defects of the organs. This has made me think of all kinds of ways and means to remedy this defect, and make the proper pitch known to both organ-builders and organists, so that the organ-builder may intone new organs, and renovate and correct old organs, by this means. For this purpose, I give a correct drawing of the proper measure for Church pitch, for the Octave beginning with what the organ-builders call the half-foot C, from which small pipes can be constructed through a whole Octave with great correctness, and used for tuning purposes by organists." Then follows a drawing, the particulars of which will be found under (1) A 424·2; the pitch I have deduced from it by having a 1 C pipe constructed from its corrected dimensions. Several little points remain in doubt, as Praetorius neglected to give the size of the mouth and the force of the wind; but the pitch measured must sufficiently represent the actual mean pitch which he finally adopted. It corresponded to the English B foot organ, and had as variations, owing to scale and pressure, from A 415 to A 428·7, besides the variations due to the original length of foot. Some of the earliest organs in this pitch are Gottfried Silbermann's celebrated Roman Catholic Church organ, at Dresden, built 1754, originally A 415, and now A 418·1; his St. Sophie, at Dresden (built 1740), A 415·5; and his organ of the Saxon Cathedal at Freiberg (built 1714), A 419·5, which, as A 419·6, is still used as the church pitch all over Spain. Singularly enough, these Saxon pitches have been regarded as remnants of the high Church pitch, and Näke assumes the existence of a chamber pitch A 375·2, a whole tone below the Freiberg Cathedral A 419·5, and belonging, really, to the early lowest church pitches. The English organ-builders, Renatus Harris, Christian Smith, Glyn and Parker, Schnetzler; Byfield, Jordan and Bridge; Byfield and Green; and Green, all, at least occasionally, used this pitch. Almost any untouched English organ in country places is a B foot organ. And when the London Philharmonic Society was founded, in 1813, and down to 1828, the pitch used was A 423·7. But the wide Continental diffusion of this pitch is most important. Marpurg's A 414·4, at Breslau in 1776, was, no doubt, really one of these pitches; probably giving A 420 when corrected. Näke cites a flute by Floth, in 1760-70, of A 418, and a D-clarinet of Grenser, in 1783, of A 422. The fork of Franz Anton von Weber (father of the celebrated composer, Carl Maria von Weber) who lived 1740 to 1812, shows A 424·1; and, at the time that C. M. von Weber himself was Kapellmeister at Dresden, 1815-21, the fork of the orchestra gave A 423·2. The pitch for which Stein, the predecessor of Streicher, constructed the pianos used by Mozart in 1780, was A 421·6, and the fork of the Saxon organ-builder Schulz (predecessor of the celebrated Schulze, of Pauluscelle) who lived in Vienna in 1780, was A 421·3. The two old pitch-pipes lent me by the bell foundry Colbacchini, at Padua, the first of about 1730, and the second of about 1770 show a mean of A 425·2 (which see). The higher F fork of the same house is equivalent to A 422·6; the lower F fork of the same first is equivalent to A 403·9, and belongs to another series. The old forks of the

bell foundry of Cavedini, at Verona, of which I was obligingly allowed to have accurate copies, belonging to about 1780, give A 422·3.[10] And, as late as 1839, the best piano-tuner at Bologna used a fork A 425·8. In France, the old fork of François, of Lille, assigned to 1754 by Delezenne, gave A 422·6, and that of Cohen, of the same place, about 1800, gave A 428·7. In 1810, Drouet assigns A 423 to the Grand Opera, in Paris; and Scheibler, in 1811, assigns A 427·0 to the same. In 1824, the pitch of this opera was lowered for a special singer (Madame Branchu) to A 425·8, evidently the pitch to which she was accustomed. In 1823, Fischer assigns A 424·2 to the Italian Opera in Paris. Dauprat's fork, preserved at the Conservatoire at Paris, gives A 423 to the comic opera there in 1820, and Fischer, in 1823, gave A 427·6 to the same.

Now, from 1670 to 1820, during which this mean pitch was in full vigour, we have the following composers:—

Belgium and France.—Lulli, Rameau, Monsigny, Gossec, Gretry, Dalayrac, Leseur, Mehul, Boildieu (operas).

Italy.—Stradella, Corelli, Lotti, A. and D. Scarlatti, Porpora, Geminiani, Vinci, Leo, Durante, Pergolesi, Galuppi, Jomelli, Marcello, Guglielmi, Piccinni, Tartini, Sarti, Sacchini, Farinelli, Boccherini, Cimarosa, Paesiello, and earlier periods of Clementi, Zingarelli, Cherubini, Rossini (all his operas), Donizetti, Bellini.

Germany and Austria.—Zachau, Keiser, Handel, Graun, Gluck, Hasse, Stamitz, J. Sebastian Bach, C. P. Em. Bach, Haydn, Mozart, Beethoven, C. M. von Weber, and earlier careers of Hummel, Spohr, Meyerbeer, Moscheles, Pleyel, Mendelssohn.

England.—Purcell, Croft, Green, Arne, Boyce, Burney, Hawkins. Webbe, Battishill, Shield, Stevens, Wesley, Calcott, and earlier careers of Horsley, Crotch, Bishop.

That is to say, the heroes of music, the founders and perfecters of modern musical art, all used this mean pitch, all thought out their music, and arranged their voice-parts to be played and sung in this pitch. This is, therefore, emphatically the classical pitch of music.

It was during this period that the great Cremona violins were made. Savart considered that the resonance power of the cavity of a violin, shown by the fork which utters the loudest tone when held before one of the *f* holes, was likely to be the pitch of the time, and on his authority, C 256 was the resonance of the violins of Stradivarius, and hence this maker was credited with adapting his instruments to that pitch, which was, therefore, assumed to be the pitch of their time. By the kindness of Dr. Huggins, F.R.S., and Rev. H. R. Haweis, together with the violin-makers, Messrs. Hart, Hill, and Withers, all of Wardour-street, I have been able to examine the resonance of several fine instruments of this period, by Duiffprugcar (Swiss Tyrol, Bologna and Lyons, 1510-1538), Amati (Cremona, 1596-1684), Ruggieri (Cremona, 1668-1720), Stradivari (Cremona, 1644-1737), Giuseppe Guarneri (known as "Joseph," Cremona, 1683-1745), Lupot (France, 1750-1820), &c.

It was often difficult to decide what fork gave the maximum resonance, as the difference between two adjacent forks was often slight. And as my forks proceeded by four vibrations each, the resonance could not be determined within less than two vibrations in a second of the pitch named, either sharper or flatter. The method adopted was to hold a fork over the widest part of the *f* hole on the "bar" side of the violin, and, therefore, most remote from the "post." By far the strongest resonance lay between V 268 and V 272; but one early Stradivari, 1696, had a fine resonance at V 264. Then there was a secondary, but decidedly weaker maximum resonance about V 252. The V 256 was generally decidedly inferior. We may, then, take V 270 as the general resonance, and about 252—say 252·4—as a secondary resonance. Now, taking the doubles of these as 1 C, we obtain C 540 and C 504·8, which would give MA 451 and MA 421·9. Now, the latter represents the mean pitch of the period very closely. (Compare Cavedini's Verona A 422·3.) And the other is a great semitone above it, which is a regular difference. (Compare notes on A 454·2 and 437·6, both of which belong to this period.) These may be mere coincidences, and may have really had nothing to do with any attempt to adjust the resonance to the prevalent pitch. This is certainly the case in the making of more modern violins on the same model and with the same resonance as the old. But, if coincidences, they are, at any rate, remarkable. And the higher resonance, corresponding to modern English orchestral pitch, may account for the possibility of playing these violins with effect at our present concerts. As the resonance is not bad, although inferior, between V 252 and V 268, it is evident that these violins will also sound well with an intermediate pitch, such as the French.

With the establishment and reception of mean pitch, the history of earlier musical pitch closes; and the extent to which I have been able to work it out, with the proofs in Table I., will, I hope, be accepted as an answer to the second objection raised against my former paper. It is necessary, however, to show the gradual passage of a universally accepted mean pitch into the lamentable conflict and confusion of pitches which now exist, and this my recent researches enable me to do more completely than before.

Art. 27. *Orchestral Pitch.*—During the latter part of the reign of mean pitch, a new power was showing itself in music—the orchestra, including the opera. Both church and chamber pitch were founded on the capabilities of the human voice alone, and the instruments were accessory. But the formation of large orchestras, for which especial music was written, gave an excessive

[10] *Ancient Variability of Italian Pitch.*—Carlo Gervasoni, of Milan, in his "La Scuola della Musica," Piacenza, 1800, p. 126, footnote says, "The tone, commonly called Pitch [*Corista*, a word also used for a pitch-pipe and a tuning-fork, although *diapason* is now also employed for the latter] is not the same in all cities, but in some it is higher or lower than in others. The pitch of Rome is, in fact, much lower than that of Milan, Pavia, Parma, Piacenza, and all the other cities of Lombardy, and the pitch of Paris is not only sharper than that of Rome, but much sharper than that of Lombardy. A mean pitch (*un corista di mezzo*), which is more generally accepted, is, nevertheless, that of Lombardy, and with this agree, more or less, the pitches of various provinces." The Lombardy pitch, then, may be taken as A 422·6, and the lower Roman as A 403·9 or A 395·2. As to the pitch of Paris, about 1800, the nearest I have are, for the Grand Opera in 1810, A 423; in 1811, A 427; in 1819, A 434; and for the Conservatoire in 1812, A 439·5, and Lemoine's fork 1810*c*, A 430—it would seem that the nearer we get to 1800 the nearer we are to the Lombard pitch. Näke, however, makes the Lombard pitch flatter (see A 415·5 and A 419·5 in Table I.). Still it would appear to have been within the limits of the mean pitch.

power to the instruments, which could develop their powers independently of the voice, and then, when joined with the voice in operas, could often exercise—have certainly, often cruelly exercised—a tyrannical power over the voice.

Down to 1816 in Austria, and later in most other places, mean pitch held undisputed sway. The most serious outbreaks against it I can find are: the French Conservatoire, which in 1812, according to a fork preserved at the Conservatoire itself, used A 439·5 (nearly three-quarters of a semitone sharper than mean pitch), and two very doubtful pitches, not precisely specified, measured in 1815 by De Prony, as A 438·2 and A 444·5. The former I look upon as an individual freak, for which I find no contemporary corroboration so that I presume the pitch was confined to the Conservatoire, and may have been only a temporary trial. The other two are laboratory experiments, and, from all the circumstances under which they were made, I cannot attach much historical value to them. It was not till after 1816 that any general rise took place and slowly spread.

According to Schindler ("Niederrheinische Musik-zeitung," 1855, Nos. 8 and 9), as quoted by Näke ("Ueber Orchesterstimmung," 1862, p. 26)—and the same story is given in the Report of the French Commission, as sent to it in a letter by M. Kittl, director of the Prague Conservatoire—the rise began at the Congress of Vienna, when the Emperor Alexander of Russia, who was colonel of an Austrian regiment, presented it with a new set of musical instruments, made by Stephan Koch, which were sharper than the mean pitch; and, under the direction of Hieronymus Payer, this band became very noted for the brilliancy of its tones. But, when its assistance was required in performing an oratorio for the return of the Emperor Francis, it was found impossible to make use of it, and much talk thence arose. In 1820, the band of another regiment (Hoch- und Deutschmeister-Infanterie) received new instruments, which were even sharper than the other. The Vienna theatres were in great trouble; for, whereas it was usual to call in the assistance of the military bands for great operas, two out of three of the regiments quartered in Vienna were no longer available, so that only one extra band remained for the theatres. The result naturally was that the theatres had ultimately to raise their pitch also. In 1823, Näke puts down Weber's "Euryanthe" as having been performed to A 437·5, and in 1834, Kreutzer's "Nachtlager" to A 440, both in Vienna; and notes (from his own hearing, apparently) A 466 as the actual pitch of the Vienna opera in 1861, during performance, which would be sharper than that officially recognised. Thus, the fork in possession of the great pianoforte-maker, Streicher, of which a copy was kindly sent to me, was only A 456·1 before 1859. The transitional pitches, A 433·9 to A 445·1—which last was regarded as a monstrosity—are noted by Scheibler before 1834. Once set the ball in motion and instrument-makers keep it well up. Yet, heightening the pitch of wind instruments does not generally improve their quality of tone; they lose richness and roundness, and incline to scream; and it is continually the wind instruments which force the pitch up.

The Vienna sharpening took some time to spread to Dresden, but Herr Näke, a Dresdener, says that in 1821 the celebrated flutist there, Herr Fürstenau, obtained a sharp flute from Koch, in Vienna. These flutes, with additional keys, were much in vogue, but they drove the orchestra up. However, Dresden did not emulate Vienna; for, as late as 1826, the fork of Kapellmeister Reissiger was only A 435; and, although Näke reports A 446 in 1861, the officials (especially Herr Moritz Fürstenau, the librarian, who has been very kind in helping me) declare that they are all perfectly unaware of such a pitch. They profess to use A 440, but the forks I have measured are one or two vibrations lower, as A 438·9, 439·4, and 437·8. It is, however, often the case that the orchestra, by heating up, plays sharper during performance, as I have just noted. See, for an excellent example, A 449·7, generated from A 445·6 at Covent-garden opera in 1879. This is a good reason for using a comparatively low pitch, for the singer's voice does not sharpen in the same way, but has rather a tendency to flatten as it becomes weary with much singing.

The Austrian influence was, of course, greatly felt in Italy, and in 1845 we find the Italian pitches at Florence, A 436·7; Turin, A 439·9; and at Milan, A 446·6, where it increased in 1856-7 to A 450·3 and A 451·7. In 1869, the information officially communicated to the Society of Arts, gave Vienna pitch (meaning, possibly, A 456·1) to Florence, Venice, and Naples. Bologna, which sent a fork, was flatter, showing only A 443·1. There was, in fact, complete want of agreement.

Although the elevation of pitch took some time to accomplish in Dresden—where it, after all, remained tolerably low—it seems to have proceeded much further and faster in Leipzig, where the celebrated Gewandhaus concerts were held, and where, in 1859, I find A 448·8, and, in 1869, nearly the same, A 448·2. A fork, sent officially from the late Kapellmeister Rietz, from Dresden, to the Society of Arts, in 1869, as the Dresden pitch, A 449·4, seems to have been a Leipzig fork sent by mistake. In Berlin, it was some time before the sharpening influence was felt. In 1806-14, Wieprecht reports A 430·5 possibly an error in calculating an equally tempered A from C 512, instead of MA 428, which would belong to the mean pitch; but I have not been able to see the original statement. Fischer, in 1822, found A 437·3; in 1830, Berlin reached A 440; and, in 1834, according to Scheibler, A 441·6. After this, progress was rapid, and in 1858, A 450·8; in 1859, A 451·8 was reached.

The whole of the German and Italian pitches were thrown back in 1859 by the introduction of the French Normal A 435·4, of which I shall have to speak in the next article.

In France, the pitch rose gradually at first. The Grand Opera was A 434 in 1819, and only A 431·7 in 1822. In 1824, however, a singer, whose voice was failing (Madame Branchu), insisted on restoring the old pitch, A 425·8, and it was five years before the opera returned, in 1829 to A 434. According to de la Fage ("De l'Unité Tonique," 1859, additional notes, p. 7), this recovery of pitch was undesigned. A single horn-player, Jean Mengal, without consulting any one, shortened his horn, and his companions either returned to their old sharper instruments or cut down their new ones. It was another case of sharpening due to a wind instrument. Of course, it is the duty of the conductor to prevent such

freaks, but conductors seem to prefer avoiding squabbles with instrumentalists; and not to care if the singers' voices are strained, and rapidly ruined. A curious thing occurred at this time at the Grand Opera in Paris. The pianos used for rehearsals had been lowered when the pitch of the opera was lowered in 1824, and were not raised when the pitch of the opera was raised; thus, in 1829, we find the pianos at A 425·5, and the orchestra at A 440, both pitches being taken from forks verified by the tuner, Monneron for de la Fage. Finally, in 1856, the Grand Opera was at A 445·8, or A 446·2, and, in 1858, at A 448. The Italian and the Comic Opera had nearly reached the same figure, and the Conservatoire also, A 446·2, according to de la Fage. The provincial French operas were generally high —as Lille, A 450·5, or 452; and Marseilles, A 447— and Pleyel's pianos were at A 446. This pitch began to frighten French musicians, and the French Commission was issued in 1859, of which I shall speak presently. Since that time, French pitch has been, nominally, A 435; what the actual pitch of the opera is, during performance, I have not been able to ascertain, but probably a little higher.

Belgium, which, in 1859, had the sharpest pitch known to the French Commission—namely, A 455·5, which it seems to have used only for military bands; and their director advocated a lower pitch for operas, as (3) A 442·5. The pitch of the Belgian Army bands is now nominally A 451, (the fork actually sent to Dr. W. H. Stone by M. Victor Mahillon was A 451·7, practically identical with Dr. Stone's British Army Regulations A 451·9).

In London, the progress has not been so rapid, and it has been once or twice checked. In 1813, the Philharmonic Concert, opened with A 423·7—that is, in mean pitch—and retained it till 1828. It is supposed to have been fixed by the conductor, Sir George Smart, after a consultation with singers. But, about 1820 to 1826, he altered his fork to A 433·2, which, as he used meantone temperament, gave MC 518·2, or almost exactly the modern French EC 517·8. This became the pitch commonly known as "Philharmonic," and was generally represented by forks sold in music-shops from 1840 to 1846. It was one of these forks (C Philharmonic 518), that Mr. Hopkins used when he examined the pitch of the Lübeck, Hamburg, and Strasburg organs, as I have ascertained by measuring the fork itself (see "The Organ," edition 1870, p. 189, in the chapter on "Pitch;" for the two first, see A 484·1 and A 489·2; I have vainly endeavoured to discover the third, but see under A 376·6.) But, from 1846 to 1854, Sir Michael Costa was conductor at the Philharmonic, and the average pitch then used, as determined from observations by Mr. Hipkins, was A 452·5. In 1874, it reached its highest point, A 454·7, since used as Broadwood's highest piano pitch. But the highest English concert pitch which I have recorded is that at the Wagner festival in the Albert-hall, measured by Mr. Hipkins as A 455·1. Pianofortes have even gone higher; thus, the Erard's fork that I measured is A 455·3; one used by Chappell's tuners, A 455·9; and, though Steinway in England uses Broadwood's and Erard's pitch, in New York he has run up to A 457·2.

The London opera fared differently. In 1857, Bettini's fork, sent to the French Society of Pianoforte-makers, is said by de la Fage to have been measured by Lissajous as A 456·1, which is higher than any modern English pitch now known; so that I think there must be some mistake. Two forks, copied from others used by Sir M. Costa when conducting at Covent-garden Opera, show A 453·4 and A 454·7. A little before 1878, the pitch had been reduced to French at both Italian operas, on the urgent solicitations (and rather more) of Mesdames Nilson and A. Patti. But, in 1878, the fork for tuning the opera at Covent-garden gave A 441·2, and Mr. Hipkins found the harmonium of the opera in that year at A 447·5, and, during actual performance of the band, he measured A 449·9. In 1879, the organ was sharpened to A 445·6. I inquired of Mr. Pitman, the organist, why the pitch had been sharpened; he said that it had been settled at the end of the season of 1878, because the oboe, bassoon, and flute could not be got to play properly to a lower pitch. Moreover, he declared that the singers themselves objected to a low pitch, averring that they could not sing in tune to it. That singers accustomed to high pitch should prefer singing in that pitch is probable, provided that the notes they have to produce do not come too near the extremities of their compass. But, if they were obliged to sing music written for the mean pitch in this high pitch, they would soon cry for transposition in the other direction. The fact remains, that here again orchestral pitch has been raised solely by the obstinacy of players of wind instruments, and without the least regard to the powers of the singers, whom they dragged after them. During actual performance at Covent-garden, in 1879, the organist held A on the organ for half an hour for the instruments to tune to. But, though the organ was tuned to A 445·6, the heat of the house raised it, according to Mr. Hipkins's measurement (made by beats), to A 449·7, which was, therefore, the real pitch of the Covent-garden Opera last season. But, according to the *Athenæum* for 8th November, 1879, the pitch is to be again reduced to the French pitch, A 435·4, on the instance of Madame Patti— "whose voice has deepened considerably of recent years at the expense of her upper register"— a reduction comparable to that of the French opera under Madame Branchu's influence. "M. Lassalle, the eminent baritone," continues the *Athenæum*, "is also said to find the difference of pitch between the Paris Grand Opera and Covent-garden very embarrassing." The management has certainly procured a fork from Paris, which I have measured and found to be in correct French pitch. So the singers have again reduced the pitch!

Of her Majesty's Theatre I cannot speak with the same detail. In 1878, the fork for tuning the organ was A 436·1; but it was, probably, at least A 440 during performance. In the winter season of October, 1879, Mr. Hipkins measured the pitch at A 445·5 during performance, and, in January, 1880, he measured the theatre fork itself at A 444·9.

Modern organs, since mean pitch was thrown overboard, have been nowhere. Most organ-builders, during the transition, put the old flat organs into Sir George Smart's pitch, A 433·2; so

that organs which have not had their pitch adjusted for thirty to fifty years seem to have French pitch, as St. Mary's, Shrewsbury, A 433·6, Fulham Parish Church, A 430·4, and, perhaps, Green's restored organ at Trinity College, Dublin, A 436·8. Most modern organ-builders will build to any pitch. The favourite is about B. Schmidt's low pitch A 441·7, but many build to French pitch for churches, and "band pitch," or about A 450, for public halls and performances, and sometimes even for churches, as Bryceson's organ at St. Michael's, Cornhill. Of course, when the church gets warmed up, the pitch rises still more, and the singers are distressed, as the organist of the last-named church complains. In fact, when we put organs into this pitch, we have, unconsciously, reverted to one of the high church pitches, as A 457·6, the great Franciscan organ at Vienna, and A 454·2, the old Brixton fork. But the music which we wish to perform is not adapted for that high pitch. Except in the last few years, it was written for the mean pitch; so that, properly, all music composed before 1820 should, on such organs, be transposed a semitone down, which would be unnecessarily inconvenient to the organist.

It is, therefore, impossible to say that there is any organ pitch or any orchestral pitch in England at the present moment, Many old organs are at mean pitch; several of them were raised about 30 to 40 years ago to French pitch, as it has been subsequently termed. Some recent organs have been originally so tuned. A few of Bernhardt Schmidt's B *flat* foot organs remain, and many new organs are tuned to this favourite pitch of modern organ builders, but not a few organs, especially those used for concert purposes—as at the Crystal Palace, St. James's and Albert-halls, Alexandra Palace and Royal Academy of Music—are at the highest pitch, A 450·6 to A 455·1. Exeter-hall is a little flatter, A 447·3. The Philharmonic concerts remain at the extremely high pitch. In smaller concerts, much depends on the piano used. Broadwood, Erard, Steinway, all use the sharp pitch for concerts, but Broadwood has a second medium A 446·2, for private, instrumental performance, and keeps French pitch for pianos to accompany private singers. Brinsmead uses the same three pitches. Other piano makers and tuners also use French pitch, as well as the high pitch, and others a so-called Society of Arts Pitch, which should have been A 444, but rises to A 445·7, 448·4, 449·4, 450·3; that is, gradually becomes the High Pitch. The military bands have quite gone over to high pitch, A 451·9, 452·9. The only standard that I know of which preserves mean pitch is that of the Tonic Sol-fa College, formerly A 427·5, but since reduced to A 422·5 or thereabouts, which is the true mean. All the Tonic Sol-fa teachers, however, do not employ this standard, and some use a much sharper pitch.

Such is the very undignified and unscientific position occupied by our own country with regard to musical pitch—a position into which we have drifted without due consideration, and which is the occasion of much practical inconvenience. It is entirely an orchestral or instrumental pitch, due to the makers, especially, of wind instruments, and maintains its ground on account of the expense of changing the instruments—£1,000 is mentioned in the probable cost of the contemplated reduction of pitch at Covent-garden—as if the price of whole orchestras of instruments bore an appreciable ratio to the loss caused by the premature ruin of one great singer's voice!

Art. 28. *The Compromise Pitch.*—The gradual increase of pitch in France—though its highest, A 452 at Lille, was less than our highest, A 455·1 to A 455·9, or Steinway's American A 457·2—alarmed French musicians, and on 17th July, 1858, a Commission was appointed by the then Government, "to investigate the means of establishing, in France, a uniform musical pitch," alleging the increase of pitch to be a great drawback to musical art, from which composers, performers, and instrument-makers all suffered, and the difference of pitch to be a constant source of embarrassment to concerted music and commercial transactions. The Commission consisted of four officials, two physicists, one orchestral composer, and five operatic composers (one of whom, M. Halévy, drew up the report), but no singer, or musical performer or musical instrument-maker of any kind. A translation of the Report, dated 1st February, 1859 (to which I am much indebted, as the original cannot be purchased), is given in the *Journal of the Society of Arts* for 3rd June, 1859. The Commission did not seem to be aware of the former general acceptance of mean pitch. They all agreed that the pitch must be lowered; one wanted to reduce by one-eighth of a Tone, several inclined to a semitone, which would have brought about mean pitch, but the majority were in favour of a compromise, and advocated the reduction of a quarter of a Tone. The actual pitch desired was A 435, and Messrs. Despretz and Lissajous, the physicist members of the Commission, were entrusted with making it. It seems that they really produced A 435·4, which must be considered a very great success. Then, on 16th February, 1859, a decree was issued for its use after 1st July, 1859, in Paris, and after 1st December, 1859, in the departments, for all places receiving Government aid, and the same decree provided for preserving the original fork and issuing stamped copies. This last arrangement has been dropped. How inefficient it was to secure perfectly accurate copies will be seen in Table I., under A 435·4. Whether the use of this pitch is still imperative I do not know, but there is, at least, one standard of music pitch, preserved in the original fork at the Conservatoire, in a form which bids fair to endure. This is one excellent result. Of course, there was a revolution in the construction of French musical instruments, and, at present, French pitch is the easiest one to find instruments for, except in London.

In Germany this compromise pitch met with great favour, and it was adopted at court theatres and some others, but by no means universally. The only place in Europe which had two distinct sets of instruments—independently of the new French—was, perhaps, Dresden. The lower was in mean pitch A 418·1 to A 424, and the higher, intentionally in Stuttgart pitch A 440, but really rather lower, A 438·9, and this the direction of the theatre thought too near to the French to warrant the expense (about £900) of a new set of orchestral instruments. In 1861 and 1862, the direction had three operas—Mozart's "Magic Flute" and "Idomeneus," and Marschner's

"Templar and Jewess"—performed in mean pitch. In consequence of the success of these performances, and partly owing to the exertions of Herr Näke (who, as a teacher of singing, was very anxious to restore mean pitch, the full historical value of which he duly appreciated), a conference was appointed, and invitations were sent out on 5th August, 1862, to the principal German and other theatres, to witness performances in both pitches, and discuss the result. This conference met in September, 1862, and witnessed the performance of Gluck's "Iphigenia in Aulis" and Mozart's "Idomeneus," both in mean pitch, and of Rossini's "William Tell" and Weber's "Euryanthe" in the usual pitch of the Dresden Theatre, and a series of private morning performances in the rehearsal-room of the theatre, consisting of Weber's overture to "Oberon," Mozart's "O cara imagine," from the "Magic Flute;" the *Scena* of Bois Guilbert, in Marschner's "Templar and Jewess;" the trio of the three ladies, "Oh, stelle! soccorso;" and "Vinto è già il mostro," from Mozart's "Magic Flute;" and "Durch die Wälder," from Weber's "Der Freischütz;" all in both pitches, in immediate apposition; and "Che pur aspero," from Mozart's "Seraglio," and the Polacca "Son Vergin Vezzosa," from Bellini's "Puritani," both in the Dresden Theatre pitch only. On 1st October, 1862, several of the gentleman invited met in the theatre, add, after a conference, the following resolution was adopted, with only one dissentient (Herr Näke).

"That a lowering of pitch to the new Paris standard appears equally desirable and satisfactory for singers and for orchestra. That quality of tone would gain, the brilliancy of the band would not be lost, and the power of the singers would not be so severely taxed or strained. That, on the other hand, it was probable that, especially in recent operas and in instrumental music, further reduction down to Mozart's pitch, as it was called [A 421·5 that is, mean pitch], would injure the brilliancy and effect of the music under the present entirely altered conditions, and, consequently, such a reduction must be rejected as unpractical. That *uniformity*, especially in the orchestral pitch which is to govern the future, must be looked upon as the principal object and chief gain, and consequently, under present circumstances, it was desirable that the Paris orchestral pitch [the compromise pitch, or diapason normal, A 435·4] should be generally adopted in Germany; a course which would be certainly welcome to singers, and be gratefully accepted."

Herr Näke contended that *uniformity* was not the principal point, but suitability and beauty. The principal object to be considered was the singer, and the preservation of his voice. That is, his standard was vocal, not orchestral; which is the reverse of that propounded in the resolution.

The report of this meeting was drawn up by Dr. Julius Pabst, and was signed by Von Koenneritz, general director of the Dresden Theatre; Franz Abt, composer, and Kapellmeister of Hanover; Bernhardt Scholz, Kapellmeister of Hanover; Gerold, director of military music, Hanover; Carl Reiss, Kapellmeister of Cassel; Edward Thiele, Kapellmeister of Dessau; Professor Loewe; Karl Naeke, singing master, of Dresden; Friedrich Kaufmann, acoustician, of Dresden; Lendel, instrument-maker, of Dresden; C. Krebs, Kapellmeister of Dresden (Rietz being too ill to attend); and Franz Schubert and J. Lauterbach, concert masters, of Dresden. Kapellmeister Taubert, of Berlin, was not present at the conference, but expressed his adhesion to the resolution, as did Kapellmeister Ernst Lampert, of Gotha.

The above account is taken from the official lithographed report furnished to musicians present, a copy of which I obtained from the direction of the Dresden Theatre, through the kindness of the librarian, Herr Moritz Fürstenau, and I wish to draw attention to the great importance of the opinion of practical musicians who had had such a remarkable opportunity of forming a judgment. To this list I should like to add the name of Mr. Turle, the venerable organist of Westminster Abbey, whose organ, built by Schreider and Jordans, originally, perhaps, an A foot organ (see A 474·1), had been reduced to mean pitch long before Mr. Turle's time, but, at the coronation of George IV., 19th July, 1821, was "slightly raised by Greatorex," Mr. Turle's predecessor; that is, was put into Sir George Smart's pitch, which was, as we have seen, identical with the French pitch of to-day. At this pitch the organ remained till 1848, when it was renovated and retuned to his own pitch, A 441·7, by Hill. After this long experience of French pitch, and high (not highest) pitch, Mr. Turle adds, "The French pitch is, in my humble opinion, a most sensible one."

It is quite hopeless to suppose that the mean pitch will be again adopted, as, although suitable to classical music, it is not suitable to modern music. It is impossible to transpose a semitone lower in an orchestra, for the violins and wind instruments would be quickly out of their depth, and our stringed instrument players are not likely to slacken their strings a semitone, as the organist of Seville Cathedral assures me that they do there, when playing with the organ. Hence it seems necessary to choose a pitch which, like the French, stands exactly halfway between the two; so that while it exactly suits neither, will do the least violence to either. It is a compromise, and, on the whole, it is always unfortunate to have to resort to compromises. But a compromise is often all that is possible. In the present case, musical compositions written for mean pitch and high pitch must both remain to be used. Instruments for playing in the compromise pitch exist. It was, also, a pitch which was for many years prevalent in England, and there must be plenty of instruments, of 30 or 40 years old suitable to it. It was a pitch used by one of our favourite conductors, Sir George Smart, and has many opinions in its favour. Not that it has remained in Germany, where it seemed to meet with so favourable a reception. None of the Governments of that country really enforced it. When the Society of Arts endeavoured to collect information through the Foreign-office, in 1869, they found it in Munich officially, in Stuttgart unofficially, and, although the older high pitch was much used, in the Court Theatres and Imperial Band, but not in other places in Vienna (and, in 1878, I found A 446·8 even at Vienna, not far from the old sharp pitch A 456·1); in the Duchy of Baden (where even the regimental bands used it); in a few theatres at Berlin (where most bands used a higher pitch), and in the Concert Society of Cologne. In other places, and even in the towns

and countries above mentioned, except in the places specified, the French A 435·4 was not in general use. Beyond France and Germany it seems to have found no favour till it was the other day (18th March, 1879) adopted officially in Madrid, and has been chosen for the coming opera season in Covent-garden.

Immediately after the French Commission had reported, the Society of Arts appointed an influential commitee of 50 members, on 3rd June, 1859, which published a report drawn up by Mr. Hullah. The committee do not seem to have closely investigated the History of Musical Pitch, and its leanings toward C 512 and C 528—which it finally recommended—seem to have arisen rather from arithmetical than from musical feeling. Indeed, in the subsequent debate, Sir John Herschel especially took the arithmetical view of C 512. It is enough to say that there were then no means of tuning C 512 and C 528 exactly, and that even now it is difficult, if not impossible, to meet with forks giving these precise pitches. But, if perfect exactness be not attained, the whole arithmetical charm is broken. Curiously enough, C 512 was approximately attained by Renatus Harris by putting the one-foot pipe with a narrow scale (one-twelfth) on B *natural*, and using meantone temperament; and C 528 was very closely reached by Bernhardt Schmidt by placing the same one-foot pipe with a wide scale (one-tenth) on B *flat*, and also employing the meantone temperament. Harris and Schmidt, and, quite recently, Willis, reached these results much more closely than Mr. Hullah, whose C 512 fork turned out to be C 524·8, or than Mr. Griesbach for the Society of Arts, whose C 528 fork is C 534·46. Such forks can be produced now with much greater exactness, but absolute exactness is Utopian. Every alteration of temperature by 10° F. would destroy it sensibly, even if attained at one mean temperature. Then, again, the arithmetical value of C 528, owing to its representation of the natural intervals of the scale by whole numbers, depends solely upon using Ptolemaic, or Just Intonation, for the major scale of C and no other. Mr. Hullah, who advances this argument in his Report of the Committee to the Society of Arts, is one of the stoutest defenders of equal temperament, to which it has no sort of application. Indeed, by neglecting temperament in the whole of this report, some curious errors have been unintentionally committed. Thus, the Committee, intending to adopt the German A 440, made it identical with C 528; whereas, on equal temperament, A 440 requires EC 523·25; so that, if their A was right, their C was much too sharp; whereas C 528 required EA 444. This involuntary sharpening was enhanced by Mr. Griesbach's errors of A 445·7 and C 534·46; so that the Society of Arts pitch, which was supposed to be but little sharper than the French, actually became one of our very sharp pitches. There is, however, no room for two compromises. The Dresden Theatre, having about A 440, did not require A 435. It would have been impossible to keep a set of instruments in the intended Society of Arts pitch distinct from French instruments. Perhaps, for this reason, the attempt has never been made. The Society of Arts pitch has been absorbed into our high pitch, and the only recognised compromise is the French Diapason Normal.

Art. 29. *Conclusion.*—I have thus endeavoured to sketch the History of Musical Pitch from 1361 to 1880. I distinguish, first, the Early Church Pitch, which was, at the same time, excessively low and excessively high, for the same reason, the exigences of ecclesiastical music, as interpreted by the human voice and the foot-rule of the country. Secondly, the Early Chamber Pitch, where the exigences of secular music made themselves felt, and the pitch was taken at intervals of the scale above and below church pitch, to allow of the instruments and organ playing together. Thirdly, the Influence of Chamber upon Church Pitch made itself felt by the construction of organs in chamber pitch. Fourthly, the construction of organs in chamber pitch led to the proposal and very general adoption of Mean Pitch for both church and chamber. To Herr Näke is due the merit of pointing out the great importance of this pitch, as having been used by the classical writers of music; and to his labours and collections (through the kindness of his widow) I am under great obligations. But he had not gone back to a period earlier than 1714, and hence had been unable to see how Mean Pitch arose; so that I consider the establishment of this pitch, and its relation to earlier usage, one of the chief results of my own investigations. Fifthly, the predominance of instruments over voices, brought about the gradual abandonment of mean pitch, and the introduction of Orchestral Pitch, which, since 1876, has led to all the modern confusion of pitch; due, not to any preconcerted arrangement, but often to accidental circumstances, such as the presentation of new instruments to a regiment, the acquisition of a new flute, the cutting down of a horn, the persistence of oboes and bassoons in playing sharp, and the expense of acquiring flatter instruments, but in all cases to the elevation of instruments above voices, that is, to orchestral motives. These alterations I trace in England to the present day, and abroad till 1859, when we arrived, sixthly, at the Compromise Pitch of the French Commission, which proposed, and in France actually carried out, a pitch which lay halfway between the Classical Mean Pitch and the modern high pitch; and I trace, in some degree, the consequences of this introduction, and endeavour to show, by the results of the Dresden Conference, that it is the only available pitch in which both modern and classical music can be executed.

But this history consists merely of my own inferences on the large series of facts which I have partly collected from others, and partly for the first time myself discovered and published. Having shown the bases on which all these pitches have been calculated, I do not think that subsequent investigation will discover any practical error—say, any error amounting to one vibration in two seconds—in the measurements themselves. The only doubt attaches to the scale, force of wind, voicing, temperature, and crowding of certain organ-pipes, as already pointed out. These facts, then, must, I believe, form the bases of all subsequent examinations on the subject. I wish they were more complete, but the difficulty of getting information is, sometimes, exceedingly great, and the time spent over obtaining a single pitch has often been so long that I

should despair of living for years enough to render my investigations really complete. A personal examination of all existing old organs throughout Europe, with visits to all great organ-builders for isolated pipes, to makers of musical instruments, to physical cabinets, and amateurs who have inherited forks, would be necessary to complete the history. I could only accomplish a small portion of this work, but the collections I have made, and present in the following tables, will enable any successors to insert their own observations by the aid of the forks which I have made purchasable, and, after my death, of my own forks, which I shall take care to make available for their use at some public institution, warned by the great loss the world has sustained by the disappearance of Scheibler's own fifty-two fork tonometer.

The two following Tables, containing the record of these facts and their authentication, really constitute my paper, and I hope they will be accepted as a sufficient reply to the objection which was very reasonably urged against the extremely insufficient account of early musical pitch in my former essay.

It is rather important that a modern should be able to realise some of the principal effects of these great changes of pitch. As regards the very gradual transition from the lowest mean to the highest orchestral pitch, which is nearly a Tone, working by very small degrees, the only feasible plan seems to be to use the human voice, pitched to different standards by properly prepared tuning-forks, as those which I used for determining the compass of the voice. But the general effect of the main difference between old and new pitch may be well illustrated by a piano tuned to Broadwood's medium pitch and in equal temperament, which is indispensible for accurate transposition, such as I have here. This is almost precisely an equal semitone sharper than Handel's pitch. Mr. Hipkins will now kindly play a very well-known air by Handel, "See the Conquering Hero comes," originally written in G, in the pitch at which Handel heard it; that is, by transposing it to G *flat* on this instrument. This is, therefore, the classical pitch. Now, descending a tone—that is, transposing to E natural—we have the same air in Schlick's low pitch, which was also the old French; that is, the lowest church pitch. Ascending by a fourth—that is, by five equal semitones, and hence playing in A natural—we have the same air in Schlick's high pitch, and as it would have sounded on the Halberstadt organ, or in Mersenne's *ton de chapelle*; while, by giving a tone higher or, playing in B, we reach Mersenne's *ton de chambre* and Prætorius's high pitch, which may, possibly, have been the pitch for which Orlando Gibbons wrote (see A 567·3). Reverting, for a few bars, to Handel's own pitch, or G *flat*, on the instrument, just to refresh our ears, we sink a semitone, to play in F at the pitch of the organ at Trinity College, Cambridge, when Dr. Robert Smith was master. Then, ascending a Tone, or playing in G, we have very nearly the effect of the same organ as Bernhard Schmidt built it, in his low pitch, before the pipes were shifted; and this is the natural pitch of the present piano. One semitone higher, or playing in A flat, gives us Tomkins's and Bernhardt Schmidt's high church pitch, as in the oldest form of the Durham organ. Now, you have listened to these seven varieties, feeling them to be, as they were played, mere transpositions. But you must recollect that they would have been all written by the same notes, and played with the same finger-keys on the organs of these different times. They are not an air transposed. They are the different sounds attributed at different times to the same symbols, just as the different nations of Europe now utter different sounds to represent the same Arabic numerals.

In the two following Tables, you will find many pitches which differ by only one or two tenths of a vibration, and others by only one or two vibrations in a second. Such pitches are practically identical. It is scarcely possible to keep apart pitches which differ even by a comma, or V 1 in V 80. But twice that amount is very perceptible indeed. And, when examining a long series, if two pitches which differed so slightly were confounded, considerable mistakes of grouping might have been committed. I have, therefore, given every pitch as accurately as I found it described, or could determine it myself, up to V 0·1 and S 0·01, both of which limits are beyond the power of the human ear to appreciate when two notes are struck in melodic succession, although they can be readily rendered perceptible mechanically. And I have throughout purposely relied only on mechanical evaluation, to the exclusion of mere estimation of ear, which I could not have trusted at all in my own case, and which I have not unfrequently, but quite unexpectedly, found decidedly defective, even in persons of undeniable fineness of perception; more especially in the estimation of the extent of musical intervals and the recollection of musical pitch. And I trust that the great length of my Tables will be excused on the ground of the musical importance of the facts which I have been enabled for the first time to bring together and appreciate.

TABLE I.

Historical Musical Pitches, proceeding from Lowest to Highest.

Arrangement.

Tuning A.—The pitches are arranged according to the value of 2 A; where possible, this 2 A has been measured direct; where some other note only could be measured, the 2 A has been calculated according to the (M) meantone, (E) equal, or (J) just intonations. All three are always calculated, but that one is placed first which is considered to have been most probably in use at the time, and the rest are added in square brackets. The corresponding 1 C, when not measured direct, is also given in all three intonations. In every case, the note measured direct is annexed, with its name alone, as A, C, F, &c., without any qualification but the mark of its Octave MA, MC; EA, EC; JA, JC; therefore, without the mark of the Octave, are always calculated tones.

Pitch.—After the letters giving the names of the notes follow the numbers of double vibrations in a second, to the nearest tenth, or one place of decimals (the number of tenths, therefore, follows the inverted period, and the number of double vibrations precedes it). For continental measures, all these numbers must be doubled to give single vibrations; thus, A 435 is called *La* 870 v.s. in Paris. When several pitches are identical, they are placed in order of date, and marked (1), (2), &c. It must be particularly observed that all pitches, especially of organs, have been reduced, as far as lay in my power, to 59° F. = 15° C. = 12° R. Unfortunately, other observers seldom indicate the temperature, but pitches of organs are generally supposed to be taken at spring and autumn mean temperatures.

Intervals between Pitches.—After the pitches follow S (meaning equal semitones) and a number, showing by how many equal semitones (preceding the inverted period) and hundredths of a semitone (following the inverted period) the A at the commencement is sharper than the zero or lowest A 370. Thus, A 444·7, S 3·18, shows that the pitch for which A makes 444 double vibrations and seven-tenths of a double vibration in a second is three equal semitones and 18-hundredths of an equal semitone sharper than the zero pitch A 370. By subtracting the S of one pitch from that of another, we find how much sharper one pitch is than the other. Thus, A 435·4, S 2·82, is (S 3·18 less S 2·82, or S 0·36, that is), 36-hundredths of an equal semitone, flatter than A 444·7, S 3·18. The rule for finding S from the number of vibrations is given in

footnote 4 to Art. 5 of the paper. As the tenth of a vibration is often less than the hundredth of a semitone, several pitches will often have the same S.

Observers.

The name in a parenthesis immediately following S is that of the observer who measured the pitch of the note in question. When only one pitch is due to a given observer, he is sufficiently described in the note on that pitch.

Cagnard de la Tour (Charles), baron, French Physicist, b. 31st March, 1777, d. 5th July, 1859, inventor of the Siren, employed his instrument to measure several pitches, here given on the authority of others, who are always named. The siren was first described by him in the "Annales de Chimie," vol. xii., 1819, pp 167-171, and was much improved by M. Aristide Cavaillé-Coll.

Cavaillé-Coll (Aristide), born at Montpelier, Department of Hérault, 4th Feb., 1811, established at Paris 1833, where he still resides, and has been long celebrated for the extreme perfection of his organ work. He determines pitch by means of copies of Scheibler's forks. I have been greatly indebted to him for assistance in every way. His little work, "De la Détermination du Ton Normal," 1859, and his "Etudes Expérimentales sur les Tuyaux d'Orgues," Comptes Rendus, 1860, p. 176, have been very useful to me.

de la Fage (Adrien), a musical writer and critic, author of "De l'Unité Tonique," 1859, intended to influence the decision of the French Commission but published too late, with additional notes, and an excellent table of pitches, which has been of great service to me.

Delezenne, died at Lille, August 20th, 1866, meteorologist and acoustician, author of numerous papers on the acoustics of music in the "Mémoires de la Société des Sciences à Lille," 1826 to 1857, of which the most important in relation to pitch is his memoir "Sur le Ton des Orchestres et des Orgues," second series, 1854, p. 1, to which I have been greatly indebted. M. Delezenne worked with a peculiar bowed monochord tuned to Marlove's V 128, and obtained pitches of organs by tuning forks with sliders, measuring the forks afterwards by this monochord (see Art. 13 above). I have great confidence in his results.

De Prony (G. C. F. M. Riche), baron, French engineer and mathematician, b. 1755, d. 1839, proposer of the system of reckoning intervals by equal semitones and fractions (which is identical with my S, but I have not been able to see his work on acoustic logarithms). He gives two pitches in his "Mécanique Analytique," Part II., 1815, p. 495, obtained by means of Euler's formula.

Drouet, Kapellmeister to the Grand Duke of Saxe Coburg-Gotha, cited by the French Commission, is stated to have sent them three tuning-forks, but the measurements were probably taken in Paris. I have not seen any memoirs by him. His pitches are cited from the French Commission.

Ellis, the author of this paper. Where my name is affixed, it means that I am responsible for the measurement, unless otherwise stated.

Euler (Leonhardt), the celebrated Swiss mathematician and physicist, b. 1707, d. 1783, gives two pitches, incidentally discussed below, A 418 and A 392·2; but I attach no great value to them.

Fischer (Ernst Gottfried), physicist, measured four pitches with great care by a weighted monochord. Berlin; Abhandl. 1822-23, pp. 187-216.

French Commission.—This is the Commission of 1858-9, which settled the Diapason Normal. The anonymous measurements given at the end of their report are probably due to MM. Despretz and Lissajous, and were possibly made with the siren, assisted by M. Cavaillé-Coll's bellows of precision. I was unable to find any of these forks in Paris (except those sent by Messrs. Broadwood), so that they had been, probably, all returned, and it was impossible to verify the pitch. But, in the case of the three forks of Broadwood, some mistakes were certainly committed.

Hill (Thomas), of the firm of Messrs. Hill and Sons, the eminent London organ-builders. Mr. T. Hill has been of great assistance to me in many ways, by allowing me to measure on his bellows old organ-pipes which he had preserved from organs he had altered, by informing me of the sharpness or flatness of several organs he has restored of which no pipes existed, and by kindly making and presenting to me ten pipes of which the measurements had been furnished by old writers. Great part of my success has been due to this valuable assistance.

Hipkins (A. J.), of Messrs. J. Broadwood and Sons, a musician, and a writer on musical instruments, who introduced equal temperament into Broadwood's in 1844-6, and who has constantly been engaged in noting, and recording on forks, important varieties of English pitch. To him I owe the loan of many important forks belonging to himself and others, which I have measured myself, and also several pitches which he took by beats with other forks that I had measured. In every possible way throughout my work, Mr. Hipkins has lent his valuable assistance to me with the utmost kindness and readiness.

Lissajous (Jules Antoine), born 1822, the eminent French physicist, inventor of the optical method of examining musical intervals, a member of the French Commission, and especially commissioned, with M. Despretz, to superintend the construction of the Diapason Normal. The pitches attributed to him are, if possible, cited from his original memoirs, or from the Report of the French Commission, but many of them are given solely on the authority of de la Fage.

McLeod (Herbert), Professor of Physics at Cooper's-hill College, joint inventor (with Lieut. Clarke) of the optical process for measuring tuning-forks, as described in Art. 15 above. I am greatly indebted to him for his verification of Scheibler's tonometer by re-measuring sundry forks for me.

Marpurg (F. W.), German musician, b. 1718, d. 1795, determined some pitches by the weighted monochord, one of which I have found in his works, and the other I have to give on the authority of the French Commission.

Naeke (Carl), Professor of Singing at Dresden, author of a pamphlet, "Ueber Orchesterstimmung," privately printed for the Dresden Conference in 1862, and presented to me by his widow, who also kindly sent me several of the valuable forks which he had collected; so that I was able to verify his measurements, which I found extremely accurate. I am greatly indebted to Herr Näke's work.

Sauveur (Joseph), b. 1653, d. 1716, an eminent French acoustician, who has left us some doubtful pitches, discussed under A 406·6.

Scheibler (Johann Heinrich), born 11th Nov., 1777, died 20th Nov., 1837, to whom we owe the conception and execution of the Tuning-fork Tonometer described in Art. 18 above, left a record in his "Tonmesser," 1834, of several valuable pitches measured by himself, all of which have been used, and are, probably, perfectly accurate.

Schmahl (H.), organist of St. Jacobi Kirche, Hamburg, who has copies of Scheibler's forks for tuning in equal temperament to A 440 and A 445, together with his A 420 and A 430 for determining pitch. By the help of these and other forks, he determined numerous pitches for me. To Herr Schmahl I am also indebted for many references to older German writers on music, especially Praetorius, with which he is well acquainted. His assistance has been very valuable to me.

Smith (Robert), D.D., mathematician, born 1689, elected master of Trinity College, Cambridge, 1742, died 1768, author of a work on "Harmonics," 1749 (second edition, 1759; and postscript, 1762), discovered the law of beats of disturbed consonances, and used a weighted monochord to measure the pitch of his organ. (See A 441·7 and A 395·2.)

Wieprecht, —, cited by the French Commission, must, I suppose, be the director of military music in Prussia of that name, who, as the Commission states, sent them a masterly letter on the subject. I have been unable to find any memoirs by him.

Wölfel, —, mentioned by M. Cavaillé-Coll as having constructed a tuning-fork tonometer on the model of Scheibler's, without any other assistance but Scheibler's pamphlet, and quite as accurate as Scheibler's. It took him two years to construct it.

Date.

This gives the date of the fork, or of the instrument measured, as nearly as can be ascertained, when it is probable that the pitch has not been changed. Organs have been frequently altered in pitch. Old forks can often only be conjecturally assigned to their date. The date of altered organs is either that of their last change, or of the time of measurement. The letters *a*, *c*, *p* after a date mean—*ante*, before; *circa*, about; *post*, after. Thus, 1800*a* means before 1800, how much before unknown; 1800*c* means about 1800, before or after; 1800*p* means after 1800, how much after unknown. But *a* sometimes means before and up to, and *p* sometimes means from and after.

Place.

The town, and, if possible, the peculiar institution (opera, conservatoire, &c.) or instrument measured are next given.

Particulars.

Then follows as good an account as can be succinctly given of the means of determining or inferring the pitch employed, so that the reader may judge of its trustworthiness.

Historical Pitches.

1. *Church Pitch, Lowest.*

A 370, MC 442·6 [JC 443·9, EC 440·0], S 0. (Ellis.) Ideal pitch, lower than any found in practice; used, therefore, as a zero point from which to measure the intervals of all other pitches in hundredths of an equal semitone. Considered as equally tempered, it gives EC 440, which shows that it is almost precisely an equally tempered minor third below A 440·2 in that temperament; that is, below Scheibler's pitch adopted by the Stuttgart Conference.

MA 373·1 [EA 375·4, JA 372], C 448·4, S 0·15. (Delezenne.) Mean of 11 attempts to measure the pitch of an open wooden pipe 1·3 metres long; height of mouth, 16 mm.; section, 86 mm. by 72 mm.; constructed by Delezenne to determine the pitch of a pipe of 4 pieds de roi. The mean of 11 measures gave 111·594 as the pitch of the pipe. Delezenne does not say what was the temperature, or on which side the mouth was placed. Compare A 373·7, 374·2, 376·6.

MA 373·7 [JA 372·5, EA 375·9], C 447, S 0·17; pressure, 3½ in. (Ellis.) 1648, Paris. Mersenne ("Harmonicorum," lib. I., prop. xxi.) gives, as the dimensions of the "lowest pipe of an organ which he had at hand," 11⅜ Fr. inches (= 318·07 mm.) in length, and 1½ Fr. in. (= 40·61 mm.) in diameter, and stopped. If Mersenne, as is probable, took only the outside measures, we must

allow 1 mm. for the thickness of the cap, and 2 mm. for the double thickness of the tube. This would make the real dimensions 317·07 mm. in length and 38·61 mm. for the diameter. I had an open pipe constructed, 318 mm. long, and 38 mm. in diam., which would, of course, give the octave above a stopped pipe of the same dimensions, and it spoke V 446·26, 447·1, 448·1 under pressures of 2½, 3½, and 4 inches respectively. Multiplying these numbers by 1141 (= 3 × 318 + 5 × 38) and dividing by 1157·26 (= 3 × 318·07 + 5 × 40·61), or 1144·26 (= 3 × 317·07 + 5 × 38·61), we can find what the pipes of the other dimensions would speak. (See rule, Art. 8, and footnote 5) We get, then, for the outside measures, V 441·1, 442, 443; and, for the inside measures, V 446·2, 447, 448 at the three pressures respectively. Considering that Mersenne, who was very inaccurate, measured outside, so that the reduced inside measures are more correct, and that the pressure was more likely 3½ inches, I assume V 447 as most likely to be the pitch of the pipe. This so nearly agrees with Bédos's A 376·6 that there can be no doubt that Mersenne's stopped pipe was intended to be in unison with an open organ-pipe of two French feet. But what note did it represent? It might be 4 F, 4 G, 4 B, or 2 C, as the two-foot pipe was used in all these senses in France. Here I have assumed 1 C 447, that is, the four-foot pipe, as V 111·75, which agrees very closely with my measures of Bédos (see A 376·6) and with Delezenne's measurements (see MA 373·1). In the other cases (see A 402·9,503·7, 563·1), I assume Bédos's measure as being probably more accurate. To show Mersenne's inaccuracy, I may mention that, in the very place where he gives the dimensions of this pipe, he says that it is of the same pitch as a brass wire ¼ French line (= ·45 mm.) in diam., 9 Fr. inches (= 243·62 mm.) in length, weighing very nearly *(proximè)* 8 French grains, and stretched by a weight of 6¾ Fr. pounds, each containing 9,216 Fr. grains. Then, by the rule Art. 13, note 6, we find V 276·8 in place of V 223·3. Again, from this string, Mersenne's own calculations should give V 290; but he immediately writes 150 in place of it, and continues to use the latter number. Again, in his "Harmonie Universelle" (livre iii., "Des Mouvements et du Son des Chordes," p. 169), he gives V 84 to the 4 Fr. feet pipe; but, in another place *(ibid.*, livre iii., "Des Instruments à Chordes," p. 143), he gives V 96, which he employs in his general table, p. 142 (where there are many misprints), and then, in a corollary to the first proposition, he notices the discrepancy (which amounts to more than a Tone), and says it is of no consequence, for people should repeat his experiment, and take what number suits them. The numbers in his table, p. 142, should be increased by at least 17 per cent.

MA **374·2** [EA 376·3, JA 373·0] C 447·5, measured 4 C 112·7, S 0·19. (Delezenne.) 1700*a*, Lille. Dilapidated small organ of L'Hospice Comtesse, the torn bellows modern, the date a conjecture by M. Mazingue (see A 384·3). There is no front, no date, no signature. The C of the principal is a square-stopped pipe, 610 mm. long (deducting thickness of cover), section 75 mm. by 58 mm. It is made of oak, and speaks badly. Beats slightly with the experimental pipe described in A 373·1. Temperature not stated.

MA **375·2** [JA 373·9, EA 377·3], C 418·8, S 0·24. (Näke.) 1714, Germany, Saxony. Chamber Pitch, according to Näke, reckoned as a whole meantone flatter than the Freiberg Cathedral organ. I think this conjecture of Näke's to be probably erroneous (see A 415·5 and 419·5).

MA **376·6** [JA 375·5, EA 378·8], C 450·5, pressure 3½ in., S 0·31. (Ellis.) 1753, Paris. Dom Bédos ("L'Art du Facteur d'Orgues," p. 77), gives a table, from which it may be calculated that his 1 C of the *prestant*, or tuning stop, was 324·84 mm. long, and 28·08 mm. in diameter (the measurement on the plates is something less, owing to the shrinking of the paper, which he estimates at 1 in 72). I had a pipe constructed 326 mm. long and 27 mm. wide, which spoke V 450·1, 451·3, 452·5, under pressures of 2½, 3½, and 4 inches respectively. Multiplying these numbers by 1113 (= 3 × 326 + 5 × 27) and dividing by 1114·92 (= 3 × 324·84 + 5 × 28·08), according to the rule, Art. 8, we obtain for Dom Bédos's pipe V 449·2, 450·5, 451·7, under these three pressures respectively, and these taken as C give MA 375·6, 376·6, 377·6 respectively, of which I select the second as most probable, and have calculated the above numbers from it. Bédos particularly rejected equal temperament as "dure et moins harmonieuse que l'ancienne" (*ibid.*, p. 429). This would give for the 4-foot pipe V 112·6. Compare Delezenne's V 111·6, under A 373·1. It does not follow that this was really Bédos's pitch, for he directs it to be brought to the church pitch, which he says was constant in France, but it could not well have differed more than a comma at this pitch V 1·4 for the 4 C), compare A 373·1, 373·7, 374·2. This is S 2·51, or only a quarter of tone less than a minor Third, below the present French normal pitch. The Rev. Sir F. A. Gore Ouseley tells me (letter, 16 May, 1878) that "in France, when Dom Bédos wrote, the "Ton de Chapelle" was about a minor Third *below* the present French normal pitch," and that "most of the old *untouched* organs in the French Cathedrals are of this low pitch." Mr. Hopkins ("Organ," ed. 1870, p. 191) says that "of the three fine organs built by [A.] Silbermann [at Strasburg], those in the cathedral, finished 1716, and that in the Protestant church, proved on trial, in 1853, to be *a whole tone below* the pitch of" that fork he had with him, and which I have measured as C 518, that is Sir G. Smart's pitch (A 433·2), or, as we should now say, French pitch. I have not succeeded in getting the Strasburg pitch, but this indication, if taken strictly, would give A 387·5, and the probability is that as Strasburg was then (Aug. 1716) a French city, the old French pitch was used, either the present (Bédos's) A 376·6, or the higher Versailles A 395·8, either of which would sound a Tone flat. Delezenne says ("Lille Mem.," 1854, p. 12) that at Gonèse, near Paris, the longest show-pipe was 2·60 mètres or eight French feet long, which would make it of this pitch. It will be observed that this pitch is almost exactly a whole tone below Handel's A 422·5. Sir F. O., in the letter already quoted, says, "I have seen a fork of the period [O. Gibbons's], said to have belonged to Adrian Batten [organist of St. Paul's in 1624, and a composer], which was more than a whole tone below Handel's fork. It was in the possession of a music-seller of Newcastle in 1839 or 1840." This is the only indication I have of so low a pitch in England.

MA **377·0** [JA the same, EA 380], MC 451·0 [JC 452·5, EC 451·9], 2 F 301·6, S 0·33, pressure 3½ inches. (Ellis.) 1511, Germany, Heidelberg. Arnold Schlick (Art. 22, n. 8) recommends that the lowest note of a small organ should be 8 F, and that the pipe should be 16 times the length of a given stroke, which his editor measured as 4⅛ Rhenish inches. This makes the length of 8 F pipe to be 6½ Rhenish feet = 2040 mm. He says nothing about the diameter, and I have supposed it may be one-sixteenth, one-thirteenth, or one-twelfth the length. Then a pipe of a quarter the length and diameter would be 510 mm. long, and 32, 39·23, or 42·5 mm. in diameter respectively. I had a pipe constructed, 510 mm. long and 42·2 mm. in diameter, which spoke V 291·8, 292·8, and 293·8 under pressures 2½, 3½, and 4 inches respectively. Now three times the length, added to five times the diameter of this pipe, and of the three other conjectural pipes, are 1741, 1690, 1723·2, and 1742·5 respectively. Hence, by rule Art. 8, dividing the V at the different pressures by the three last numbers respectively, and multiplying by the first, we obtain the following V for the three kinds of pipe: at 2½ inches, 300·6, 294·3, and 291·6; at 3½ inches, 301·6, 295·3, and 292·6; and 4 inches, 302·7, 296·3, and 293·6 respectively. These, taken as F, give respectively for A considered a just major Third higher, for the three kinds of pipe: at 2½ inches, A 375·8, 367·9, and 364·5; at 3½ inches, A 377·0, 369·1, and 365·8; and at 4 inches, A 378·3, 370·4, and 367·0. These numbers show about the limits of uncertainty. But as I consider it probable, from an examination of Bédos's proportions, that this 8 F had a diameter about one-sixteenth of its length, I have selected A 377 as the most probable pitch, and calculated the above accordingly, choosing the meantone temperament, because it cannot have differed materially from that which Schlick himself recommends. Schlick, however, also allowed this pipe to stand for 2 C, which will therefore be C 301·6 on the same supposition, (see MA 504·2).

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2. *Church Pitch, Low.*

A **384·3**, MC 459·7 [EC 457·0, JC 461·1], S 0·63. (Delezenne.) 1700*c*. Old Fork found before 1854 in an old iron shop at Lille by M. Mazingue, composer and organ-builder. It sounded so badly that it could only be heard for a moment when placed close to the ear. The stem is large and without a button. Delezenne says that, as a major Second, above V 384·3 is V 432·3, "of the violins of Stradivarius, we may conjecture that it was a century and a half old. It is also perhaps the fork used to tune St. Sauveur" (see A 384·6). He does not give his authority for the A 432·3 of Stradivarius. It would seem as if he assumed C 256 as the pitch of the resonance of a Stradivarius violin (on which see above, end of Art. 26), and then taking 4 C 128 to be in consequence the lowest note of the viola, reckoned 3 perfect Fifths up; giving 2 A 432, which see. It is difficult to see how the fact of a fork being a whole Tone flatter than the supposed pitch of Stradivarius should lead us to assign it to his date.

A **384·6**, EC 457·2 [MC 460·0, JC 461·5], S 0·69. (Delezenne.) 1851, Lille. Organ of St. Sauveur, rebuilt at this date, but pitch probably nearly preserved. It belongs to the same class as A 384·3. (See A 432·2.) Equal temperament was probably adopted in 1851.

A **392·2**, MC 466·14 [EC 469·1, JC 470·6], S 1·00. (Euler. "Tentamen novæ Theor. Mus.," cap. 1, §§ 8, 9, and 10, pp. 6 and 7, giving the theory of determining the rate of vibration of a string.) 1739, St Petersburg, Clavichords (according to Marpurg.) Euler gives as an example, length of string 18·667 English inches, weight of string 6·2 grains, stretching weight 46·082 grains, whence (by the formula in Art. 13.) V 196·1, and observes "huic autem sono congruere deprehendi clavem signatam a." He does not say whether this is any particular pitch, or whether it is organ pitch or concert pitch, or Russian or German pitch. Hence it is quite indeterminate.

(1) MA **395·2** [JA 393·9, EA 397·5], MC 472·7 [JC 469·8, EC 470·8] D 528·5, S 1·14. (Dr. R. Smith, Cambridge.) 1759. Trinity College Organ built by Bernhardt Schmidt 1708, after it had been new voiced, and by altering the disposition of the keys depressed a tone lower and thereby reduced to the Roman Pitch, "as I (Dr. R. Smith) judged by its agreement with the pitch pipes made about 1720," (R. Smith, "Harmonics," second edition, 1759, p. 148). For the calculation of the D see MA 441·7. It was measured by means of a weighted wire brought into unison with a lower Octave. Mr. C. A. Bishop informs me that he has "cut down a Father Smith chamber organ to Smart's pitch," that is, to A 433·2. It is possible therefore that B. Schmidt made chamber organs in this low pitch himself, which would be a minor Third flatter than his sharpest pitch, A 474·1. This organ to which Bishop alludes may, however, have been only in Handel's pitch, A 422·5, or may have been previously lowered.

(2) MA **395·2**. (Dr. R. Smith.) Rome, 1720, from pitch pipes compared with organ of Trinity College, Cambridge, in 1759, see A 403·9 and preceding entry.

A 395·8, MC 478·5 [JC 475·0, EC 470·7], S 1·17. (McLeod and Ellis.) 1789, France, Versailles Organ. Copy (compared with the original, which is in good condition) of a fork (No. 410 of catalogue) in the Musée du Conservatoire at Paris, which belonged to the Abbé M. C. Roze (1745–1819) who was librarian of the Conservatoire during tho twelve last years of his life. It gives the A of the chapel of the palace of Versailles in 1789. M. Cavaillé-Coll, who compared the copy with the original, considers it to be perfectly authentic, because about ten years previously, when repairing this organ, he had noticed that its pitch was about a Tone (actually 1·65 eq. sem.) lower than the ordinary French pitch. The temperature at which the pitch was taken is not known, probably a mean temperature would have been chosen. The original fork is four inches from bend to point inside, and the prongs are three-eighths of an inch apart at the end of the bend, and three-sixteenths of an inch at the end of the prongs, stem flat at end; rusty in some places, but not very much. This organ was built by Charles Dallery and François Clicquot.

MA 396·4 [JA 395·1, EA 398·7], C 474·1, pressure 3¼ inches, S 1·19. (Ellis.) 1615, Palatinate of the Rhein. Solomon de Caus ("Les Raisons des Forces Mouvantes," Franckfurt A.M. 1615, Liv. 3me., traitant de la fabrique des orgues) fixes the F pipe as 3 feet and the C pipe as 2 feet Rhenish. I take, then, the 1 C pipe as one Rhenish foot (= 313·85 mm.) in length, and assume the diameter to be one-twelfth the length (= 26·15 mm.) as in B. Schmidt's B *flat* (see (1) A 441·7.) I had a pipe constructed 315 mm. long and 25·5 mm. in diameter, which spoke V 472·85 and 474·04 under pressures of 3¼ and 4 inches respectively. Correcting according to the rule Art S, by multiplying by 1072·5 (= 3 × 315 + 5 × 25·5) and dividing by 1072·3 (= 3 × 313·85 + 5 × 26·15) we obtain C 472·9 and 474·1 respectively, whence MA 395·4 and 396·4 respectively; and selecting the last pressure as most probable, we obtain the above numbers.

A 398·7, EC 474 (MC 476·9, JC 478·4), S 1·29. (Delezenne.) 1854*a*. Lille, old organ of La Madeleine restored.

3. *Chamber Pitch, Low.*

MA 402·9 [JA 400·4, EA 401·3], MA 482·0 [JC 480·5, EC 477·3.] B *natural* 450·5. S 1·48. (Ellis.) 1648, Paris, Mersenne's spinet. In the diagram which he gives (De instrumentis, lib. i., prop. 41) the keyboard begins with B *natural*, and (Harmonie Universelle, lib. iii., des instruments à chordes, p. 143) he says that the lowest string is in unison with the 4 foot pipe, for which I take Bédos's value (see A 376·6, and A 373·7.) In Germany Praetorius makes almost all the old organs begin with B *natural* (Syntagma Musici, vol. 2, p. 112).

MA 403·9 [JA the same, EA 407·1], MC 483·2 [JC 484·7, EC 484·1], 1 F 646·2, S 1·52. (Ellis.) 1730, Padua. Copy made for me, under the direction of Prof. Rossetti, of the old lower F fork preserved in the bell foundry Colbacchini of Padua (see A 425·2 for references.) This is the nearest approach to Dr. R. Smith's Roman pitch-pipe (see (2) A 395·2) which I have found in Italy. It is nearly a semitone flatter than Colbacchini's pitch-pipe, and hence could not have been Zantedeschi's F, which he found to be a semitone sharper than these pipes.

MA 406·6 [JA 405·2, EA 405·8], MC 486·4 [JC 486·4, EC 482·6], 4 E 152, S 1·63. (Sauveur, "Mém. de l'Académie Française," 1713, p. 335.) Sauveur made many attempts to determine pitch, giving C 487 (whence MA 407·1), and A 408, as well as the present pitch. The C 487 is derived from V 121·75, which he obtains from his formula for the number of simple vibrations of a string, 40 Paris inches (42·631 Eng. inch) long, weighing 20½ grains French, and stretched by a weight of 92·160 grains, the whole length of the string between the bridges being 67 Paris inches (which is indifferent.) By the formula Art. 13, n. 6, this gives only V 101·3, a very serious difference, so that there must be an error somewhere. In 1700 he considered the 5 (French) foot pipe to give 100 vib., but he corrects this in 1713 to 102, which he identifies with the lowest A of the clavecin, thus reaching A 408. Sauveur, in 1700 ("Hist. Acad.," pp. 134-143) wished to make the five foot pipe his standard of 100 vibrations. In his final memoir of 1713, he says that he made several experiments on four different days, in 1699, 1700, and 1704 at the works of the organ-builder Deslandes, in presence of Father Sebastien Truchet, and many others, using organ pipes of four and two feet, and that he found the E below the key of F-ut-fa made V 152. From this he calculated JC 243·4, and I have calculated the above. We have therefore from Sauveur, MA 407·1, A 408, MA 406·6, which agree fairly well, and also agree with Taskins' fork A 409, which see. It is to be observed that Sauveur mentions no particular clavecin, or organ, or opera, so that his results can only be looked upon in the light of experiments. On Sauveur's methods see end of Art. 17.

M 407·1, C 487. (Sauveur.) See A 406·6.

A 407·3, EC 484·31 [MC 487·2, JC 488·9], S 1·66. (Delezenne.) 1854, Lille. Organ of St. Maurice, repaired. Apparently an old pitch preserved It is exactly an equal semitone higher than Mazingue's old fork, A 384·3.

EA 407·9, C 484·8 [EC 485·0, MC 488·0, JC 489·5], S 1·69. (Schmahl and Ellis.) 1762, Germany, Hamburg. St. Michaelis Kirche, organ built (1681-99) by Hildebrand, of Dresden, under the direction of Handel's early friend, J. Mattheson, the composer, who contributed 44,000 marks banco = £3,221 3s. 4d. towards its expense. It was in the chamber pitch of the period, and its pitch has never been changed. It is a magnificent organ, containing 68 speaking stops and 4,945 speaking pipes, and by recent improvements of the wind, under direction of Herr Schmahl, it has been brought into first-rate condition. It is S 0·93, or almost an equal semitone flatter than French pitch, and is exactly a *just* (not an equal) minor Third flatter than the St. Jacobi organ. A 489·2. The pitch was measured from C and E *flat* by Herr Schmahl with forks measured by me. The EA from the C was V 407·7, but Herr Schmahl advised me to go by E *flat*, the difference is only V 0·2; and is quite unimportant. It is certainly now in equal temperament, and was possibly always meant to be so. As Mattheson knew Schnitger, the builder of St. Jacobi organ (See A 489·2), Herr Schmahl thinks that the just minor Third between the organs was intentional, and that while St. Jacobi was in the true high church pitch of the period, St. Michaelis was in the true chamber pitch. Certainly, these are the best existing representatives of these pitches.

A 408. (Sauveur) see MA 406·6.

A 409, MC 489·27 [JC 490·8, EC 486·38], S 1·74. (Lissajous, "Bull. Soc. Encour.," liv, 1865) 1783, Paris. Court Clavecins. Fork of Pascal Taskin, their tuner, tuned from A of oboe of Antoine Sallentin, of the Opera and Chapelle du Roi, given by Taskin to M. Pfeiffer, who possessed it in 1859, according to de la Fage.

A 410, MC 490·46 [JC 492, EC 487·56], S 1·78. (Lissajous, "Bull. Soc. Encour.," liv, 1865.) Eighteenth century, Paris. Pitch-pipe found by Lissajous in the Cabinet of the Faculty of Sciences. Temperature under which it was measured, and force of wind not stated.

A 411·4, EC 489·2 [MC 492·1, JC 493·7], S 1·84. (Schmahl and Ellis.) 1688, Germany, Hamburg. The Chamber Pitch on the former eight-foot Gedact of the organ of St. Jacobi Kirche, being an equal minor Third flatter than the church pitch of the organ itself, so that the C of this stop was in exact unison with the A of the other stops of the organ; see A 489·2.

A 413·3, MC 494·36 [EC 491·4, JC 495·9], S 1·91. (Näke.) Germany, but neither date nor place mentioned. The Fork labelled "Schneider's oboe 826·5," formerly belonging to Herr Nake, and lent me by Frau Näke. My own measurement was the same as Herr Näke's.

MA 414·4 [JA the same, EA 411·1], MC 495·7 [JC 497·3, EC 488·9] C sharp 518, S 1·96. (F. W. Marpurg, Versuch über die musikalische Temperatur, Breslau) 1776, Clavichords. This is the result of an experiment made by Marpurg to tune a stretched wire to his C *sharp*, and calculate its pitch by the usual formula. This is a little flatter than Euler's MA 418. Marpurg himself determines JA, and then JD 276$\frac{4}{9}$, as a just Fifth below it, but this JD is in the major scale of A, and is therefore a comma lower than D in the scale of the JC here given, which is calculated as a just minor Third above the A. Of course we must not be too certain of the exactness of these numbers, on account of the method by which they were obtained.

4. *Mean Pitch of Europe for Two Centuries.*

A 415, MC 496·5, JC 498, EC 493·5] S 1·99. (Ellis.) 1824*a*, Dresden. Roman Catholic Church, built by Gottfried Silbermann, 1754; see A 418·1 for present pitch. The above was taken from a fork formerly chained to the organ, for the purpose of giving the pitch to the orchestra that always plays with the organ in this church; these chained forks seem to have been placed there by command of King Friedrich August der Gerechte (1763-1827), who would not allow the pitch of the organ to be changed. The fork I measured, which had the perfect chain and staple still attached, was lent me by Frau Näke of Dresden, and sent by Herr Moritz Fürstenau, librarian to the Court Theatre, in 1878. Attached to it was a label giving the pitch as 415·1083, from the late Herr Näke's measurements by Scheibler forks, from which mine differs only by 0·1 vib. Herr Näke gives the pitch of another of these forks, in his book, as 415·3055, so that 415 may be regarded as the pitch intended; these forks disappeared from the church after 1824. Herr Näke says that the pitch of the fork was selected by the Kapellmeister Morlacchi and Carl Maria von Weber, assisted by the Court organ-builder Uthe, to give the pitch of the organ in spring and autumn.

A 415·5, MC 497·1 [JC 498·6, EC 494·1], S 2·01. (Näke.) 1722, Germany, Dresden. Organ of St. Sophie, built by Gottfried Silbermann. Näke conjectures that this pitch was brought from Venice by the Kapellmeister Antonio Lotti, who, in 1717, first conducted a grand Italian opera in Dresden, before Augustus the Strong, and says it was then called chamber pitch. This may be the case, and I consider these pitches, A 415, 415·5 to 419·5 to be only flatter forms of the Mean Pitch A 422·5. In that case, however, Näke must have been in error in supposing there was another chamber pitch a whole tone lower, see A 375·2. That could only have been a low church pitch.

(1) **MA 418·0** [EA 420·4, JA 416·7], C 500, S 2·11. (Euler, "De motu aeris," Nov. Com. Ac. Sci. Petrop., vol. xvi. for 1781, p. 335.) 1780, St. Petersburgh, organs. Euler, after remarking that in a tube of 1,000 feet, open at both ends, the number of oscillations made by the air would be also 1,000, and in one of eight feet would be 125 (these tubes are to be carefully distinguished from organ pipes) incidentally observes, "cui numero (125) respondet sonus in instrumentis musicis litera C indicari solitus." (To this number, 125, corresponds the note usually marked C in musical instruments, by which perhaps organs are intended.) I do not think that either this or the former (see A 392·2) observations are to be taken as determining precise pitches. This pitch

is 1·11 eq. sem., about a great semitone sharper than A 392·2, which gives B *flat* 419·6, so that the two instruments would be related in the manner explained under A 454·2 and A 457·6.

2) A **418**, MC 500·1 [JC 501·6, EC 497·1], S 2·12.*(Näke.) 1760-90, Germany. A flute made by Floth gave this pitch when Näke observed it, but all determinations by flutes are most uncertain. Delezenne says (Lille Mem., 1854, p. 6): "A flute, an oboe or a clarionet gives the pitch in the orchestra; hence orchestral pitch is delivered over to the caprice of the manufacturer, and it also depends on the *embouchure* of the artist, as I have ascertained by my tonometer that the same flute gives different sounds in different hands. Similarly, I have established, in conjunction with M. Hermann, Laureate of the Conservatoire, and first flute in the Lille theatre, that a flute may be made to vary in pitch by 5·4 commas [= S 1·16], that is by more than a semitone, according to the closeness of the lips, and the force with which the lamina of air is driven against the edge or the middle of the hole. For this reason I have renounced my attempts to discover ancient orchestral pitches by means of old flutes, of which I had already formed a collection for that purpose." See A 426·5.

A **418·1**, EC 497·2 [MC 500·2, JC 501·7], S 2·12. (Ellis.) 1878. Germany, Dresden. Roman Catholic Church, Silbermann's organ, from a fork tuned for me by the Court organ-builder, Jehmlich, at 15° R. and reduced. For older pitch see A 415. The C was taken at the same time, and being similarly reduced, gave C 496·4, which is only ·8 vib. too flat. At what time equal temperament was adopted is not known.

MA **419** [JA 417·7, EA 421], C 501·3, S 2·15. (Ellis.) London, about 1700, organ of St. John's, Clerkenwell, attributed to Renatus Harris. When measured (1 Oct., 1878), the pressure of wind was very weak. It was ill regulated by broken gravestones as weights. The choir organ was measured, which is 1 vib. sharper than the great organ. It has the "short octave," see A 424·3 and pedal keys without pipes, and had originally no couplers. The organ has been put into equal temperament, but very slightly changed; the old temperament is here assumed. This organ is reported to be at least part of the one put up in the Temple in rivalry to B. Schmidt's, but the church books have been impounded for a lawsuit, and are inaccessible, so that this statement cannot be verified.

MA **419·5** [JA 418·2, EA 422], C 501·8, S 2·17 (Näke.) 1714, Saxony, Freiberg; organ built by Gottfried Silbermann. Näke says the pitch is A 422 equally tempered, but that the organ is *not* tempered. I presume then that he measured C, and then deduced EA. I have calculated backwards, and from C have calculated both MA and JA, and, thinking MA more probable, have calculated S from it. Näke may have confused JA and MA, being probably unacquainted with the latter. Näke conjectures that this pitch was introduced by Heinrich Schütz in the 17th century from Italy, and that it had become gradually higher. He calls it Lombard pitch. He says also that this organ is in high church pitch, two semitones above chamber pitch. Taking this as one mean tone, it would give the chamber pitch at MA 375·2; see this pitch and also A 415·5.

(1) EA **419·6**, EC 498·93 [MC 501·8, JC 503·46], S 2·18. 1858 Madrid, ton de chapelle. This was calculated as an equal semitone lower than A 444·5 (which see) on the authority of de la Fage, but the temperament used may, after all, have been the meantone temperament. See next entry.

(2) A **419·6**. (Ellis.) 1785-90, Spain, Seville Cathedral. This fork was tuned by me, and sent to Seville to compare with the old organ of Torje Bosch (a Spaniard of Majorca) and was pronounced by the organist, Don Yñiguez, to be exactly in unison with 2 A of the organ at a mean temperature. He also informed me that in Spain they have not abandoned the system of Salinas, or the meantone temperament, and that the band played with the organ by screwing down the strings of bowed instruments, and adding pieces to the wind instruments for the occasion. He also said that this was the pitch of all organs in Spain. As the precise temperature was not stated, there may be an error of two or three vibrations, but not more, in supposing this mean temperature to be 59° F. It might thus be as high as Handel's pitch, A 422·5.

A **419·9** (measured 4 A 209·93), MC 502·3 [JC 503·8, EC 499·3] Rev. G. T. Driffield, rector of Bow, possessor of Handel's fork, S 2·19. (Ellis.) About 1715, England. Very old fork, belonging to see A 422·5. This is a large rude tenor fork, pyramidical at end of stem, difficult to measure as its beats in the octave could scarcely be counted for more than 5 sec. Mr. Driffield thinks it was made by John Shore, the inventor of tuning forks, see Art 10 above. This 4 A would be the tuning string of the lute, and John Shore was lutist to the Chapel Royal.

MA **420·1** [JA 418·82, EA 423·6], C 502·6, S 2·20. (Ellis.) 1780, England, Winchester College organ, built by R. Harris 1681, and repaired by Samuel Green, 1780. The C measured at Messrs. Bishop's works was a stopped diapason, and Mr. C. K. K. Bishop, put the tuning ears in the ordinary position, but he may have possibly flattened it. The tone of the pipe was very dull. The pipe was one of Green's. See A 422·6.

A **421·3**, MC 504·0 [JC 505·5, EC 501·0], S 2·25 (Näke.) 1780, Austria, Vienna. Fork of the Saxon organ-builder, Schulz, who lived in Vienna in Mozart's time, giving the pitch of organs then used. Herr Näke's full measure was 421·2885.

A **421·6**, MC 504·3 [JC 505·9, EC 501·3]. S 2·26. (Näke and Ellis.) 1780, Vienna, pianos. Fork of Herr Stein, the celebrated clavichord maker of Vienna, in possession of his son-in-law, Streicher, the celebrated pianoforte maker at the same place. A copy of this fork, made for Herr Näke, was kindly lent to me by Frau Näke, and I measured it as above; Herr Näke had measured it as 421·3625. The difference is unimportant. Herr Näke usually cites it as 421·5. This was the pitch to which Mozart's clavichords and pianos were tuned, and this was in fact Mozart's pitch, being almost imperceptibly different from Handel's, A 422·5.

A **421·9**, MC 504·7 [JC 506·2, EC 501·7], S 2·27 (Marpurg as cited by the French Commission.) 1752, Berlin, Opera. I have been unable to find this in any of Marpurg's works accessible to me, but see A 414·4. The pitch is very probable.

A **422**, MC 504·8 [EC 501·85, JC 506·4], S 2·28 (Näke.) 1783, Germany. A clarionet in D with two keys, by A. Grenser. See Delezenne's observations under (2) A 418.

(1) A **422·3**, MC 505·2 [JC 506·8, EC 502·2], S 2·29 (Näke). 1789. Dresden, fork of the former Court organist, Kirsten; in possession of the late Court Organist, Dr. Schneider.

(2) A **422·3** (Ellis), 1780*c*, Verona. The bell foundry of Cavedini at Verona has two C forks, and one series of forks from C to B flat. Copies of all these forks were kindly made for me under the direction of Prof. Rossetti (see A 425·2 for references) with the assistance of Sig. Cavedini, who attested their accuracy. The C was believed to be the Roman C of 100 years ago. The following are the pitches of the whole series:—In the two foot octave, C 246·44, C *sharp* 263·64, D 281·24, E *flat* 292·72, E 317·54, F 330·27, F *sharp* 355·14, G 376·23. G *sharp* 405·72, A 422·34, B *flat* 449·44, the B *natural* is wanting. On examining the series, the forks will be found to be very imperfectly tuned. Every major Third is much too sharp, and hence every Fifth is slightly too sharp. Remembering that in equal temperament the Fifths are S 0·02 too flat, and the major Thirds S 0·14 too sharp, we may see how bad the present scale would be in harmony, where the Fifths *c g*, *e* sharp *g* sharp, *d a*, *e* flat *b* flat, are respectively S 0·31, 0·44, 0·02 and 0·40 too sharp, and the major Thirds *c e*, S 0·53; *c* sharp *e* sharp, S 0·04; *d f* sharp, S 0·18; *e* flat *g*, S 0·48; *e g* sharp, S 0·34; *f a*, S 0·39; *f* sharp *a* sharp, S 0·21; too sharp. Now Zantedeschi says that on comparing this C 246·4 with the (more recent) pitch-pipe of Colbacchini he found it was D, which has really V 288·9, and consequently concludes that the fork had risen a Tone. Probably the bad state of the pitch pipe rendered it impossible to measure with any degree of accuracy. Cavedini's C 246·4 is actually flatter than the C 252·13 of the pitch pipe, see A 425·2. Zantedeschi also says that the theatre at Verona used the Vienna A (which he estimates at V 265 to V 268), and was a semitone sharper than the C of the Colbacchini pitch pipe, which has C *sharp* 272·4. But the Vienna pitch seems to have been A 456·1 (which see) giving JC 273·6, which is indeed very nearly C *sharp* of the pitch pipe, so that if the least reliance could be placed on Prof. Z.'s observations (which I am afraid is not the case), the old Vienna pitch, as given by Streicher's fork, is confirmed.

(1) A **422·5**, MC 505·4 [JC 507, EC 502·4], S 2·30. (Ellis.) 1751, England, from a copy made by myself (and compared with the original some months afterwards, when it was found perfectly exact) of Handel's fork. The box containing it bears this inscription:—"This Pitchfork was the property of the Immortal Handel, and left by him at the Foundling Hospital, when the Messiah was performed in 1751. Ancient Concert, whole tone higher; Abbey, half-tone higher; Temple and St. Paul's organs exactly with this pitch. Presented to Rd. Clarke by J. Brownlow, the Dep. Sec., 1835. Invented by M. Shore, Serj. Trumpeter. time of H. Purcell." This fork was bought by Rev. G. T. Driffield, rector of Bow, near London, at the sale of the effects of Mr. Clarke, and by his permission I took and compared the copy. The fork is probably far superior to any made by John Shore, who (and not Mathias Shore, as the inscription implies) was the inventor of the Tuning-fork, see Art. 10 above. This fork probably represents the exact pitch of the organ built by Messrs. Glynn and Parker (see (2) A 424·3), which was presented by Handel to the Foundling Hospital, and opened by him "on the 1st of May, 1750, when the concourse of persons was so great that the performance was repeated fifteen days afterwards. Upon one of these occasions the audience was conveyed in no less than 800 coaches and chairs" ("John Brownlow's History and Objects of the Foundling Hospital," third edition, London, 1865, p. 78). This fork was received by the secretary, John Brownlow, from his predecessor, who was in office from 1795 to 1849, and Mr. Brownlow in a letter to Mr. Driffield, dated May 21, 1848, says, that "in an unguarded moment" he gave it to Mr. Clarke. He did not remember the story of Handel's leaving it in the orchestra, and imagined that that might be "apocryphal." Mr. John Reid, a partner in Messrs. Broadwood's house, writing to Mr. Driffield on June 13, 1859, says that that house had once possession of Handel's fork, and they do not know how it came out of their possession. Handel was a friend of Tchudi, the founder of the house. Richard Clarke, to whom the fork was given, died Oct. 5, 1856, aged 76½, and his effects were sold by auction, May 2, 1857, when Mr. Driffield bought both this fork and A 419·9. I am indebted to Mr. E. J. Hopkins, of the Temple organ, for furnishing me with a MS. note made by Mr. Leffler (d. 1819), organist of St. Katherine's, then by the Tower, with Mr. W. Russell, then organist of the Foundling, which describes the great peculiarity of this organ. It had the usual 12 keys to the octave, but a means of altering the notes sounded by four of them. There was a slider with three rests above the draw stops on each side. When the sliders were at the central rest, the 12 notes were the usual 12 of the meantone temperament, E *flat*, B *flat*, F, C, G, D, A, E, B,

F *sharp*, C *sharp*, G *sharp*. If the left-hand slider were put full to the left, E *flat* was changed into D *sharp*, and if the right-hand slider were put full to the right, B *flat* was changed into A *sharp*. If, however, the right-hand slider were put full to the left, G *sharp* was changed into A *flat*, and if the left-hand slider were put full to the right, C *sharp* became D *flat*. These three positions of the sliders may be indicated thus: Left hand, D *sharp* —(E *flat*, C *sharp*)—D *flat*. Right hand, A *flat*—(G *sharp*, B *flat*)— A *sharp*. The two notes in the parenthesis are the usual notes of the meantone temperament, when unaltered by the sliders. There were were separate sets of sliders for swell, great and choir organs. Mr. Hopkins always understood that this arrangement was due to Dr. Robert Smith, of Trinity College, Cambridge. The sliders, long disused and not understood, were removed by Mr. Bishop, by order of the organist, Mr. C. Edwin Willing, who was appointed in 1848, but "the organ was still tuned in unequal meantone temperament, to avoid the alteration in the pipes and any further expense" (letter from Mr. Willing, then organist, Sept. 21, 1863). Its present state, after rebuilding by Bevington, is described in "Hopkins on the Organ," ed. 1870, p. 467. As respects the indications of pitch in 1835, given by Mr. Clarke in the inscription on the box, it is possible that both the Temple and St. Paul's organs were originally tuned at A 441·7, but had been flattened (the first in 1843) by Mr. C. A. Bishop to agree with Sir George Smart's pitch, A 433·2, which would be probably considered the same as Handel's by Mr. Clarke. The Temple Organ and the oldest Durham organ had an E *flat* and D *sharp*, an A *flat* and G *sharp*, that is two and not four additional notes, and these were introduced by divided keys and not by sliders. The alteration of pitch was made partly by shifting, and partly by piecing the pipes. The Temple Organ was put into equal temperament about 1865, and then the back parts of the divided keys were unused. Mr. Clark seems to be entirely in error respecting the Ancient Concerts, as these concerts were held in the Hanover-square Rooms after 1804. In 1805 that organ was built by Elliott, in the usual flat pitch of the time (that is about A 422·5); then it was sharpened by Hill, when Knyvett was conductor, 1831-7, and was probably put into Sir G. Smart's pitch (A 433·2). Aftewards, while Costa was conductor of the Philharmonic Concerts, 1846-54 (see A 452·5) it was sharpened to his pitch, certainly not S 1·2 above Handel, that is, very far short of a tone, though more than a semitone.

(2) A **422·5**. 1820*a*, England, Westminster Abbey Organ, built by Schreider and Jordans. The pitch is conjectural. Mr. T. Hill says it was a "flat organ," so that it must have been near this pitch, and that he sharpened it himself. The present pitch is therefore intentionally his standard, A 441·7. Dr. Stone's observations, in May, 1877, made it A 438. Mr. J. Turle, of the Abbey, informs me that the pitch was originally flat, but after the coronation of George IV., 1821, it was slightly raised, by desire of his predecessor, Greatorex; and that this pitch was unaltered when the organ was reconstructed by Mr. Hill in 1848, up to which time it had a "short octave," or G organ (see A 424·3), and was in mean tone temperament. As Mr. Hill says, he sharpened it, most probably the organ was raised in 1821 from A 422·5 to A 433·2 (which see), or thereabouts as this was the pitch of the period, that is, by S 0·43, or not quite a quarter of a tone; and the subsequent smaller rise to A 441·7, or thereabouts, being only S 0·35, or a comma and a half, was not noticed. Organs are constantly raised slightly in pitch when reconstructed, owing to the trimming of the pipes and clearing the dust from the mouth. See end of notes on (1) A 427·2. But there is some reason to suppose that when the organ was first built in 1730, it was a very sharp organ (see A 474·1), and that it was flattened a whole tone before Mr. Turle knew it.

(3) A **422·5**. 1838, England, Bath Abbey Church as rebuilt by Smith, of Bristol. Sharpened by Mr. T. Hill, who told me that it was a "flat organ," and hence must have been near the pitch here conjecturally assigned. As it was originally built by the Jordans, it may have been much sharper at first (see A 474·1).

(4) JA **422 5**. 1877 *a*, England. Tonic Sol-fa Standard, using JC 507 only, and the whole scale in just intonation.

(1) A **422·6**, MC 505·6 [JC 507·1, EC 502·6], S 2·30 (Delezenne.) 1754*c*, Lille. Very old fork found in the workshops of M. François, sen., musical instrument maker at Lille. Judging from its construction and that of its case, Delezenne considered it to be one hundred years old in 1854.

(2) MA **422·6**. (Ellis.) 1790*c*, London; Samuel Green's organ at Kew Parish Church, built as a chamber organ for George III., and kept in Kew Palace till it was given to the parish by George IV. in 1824, quite untouched, and, when examined in 1878, in the meantone temperament.

(3) MA **422·6** [JA the same, EA 425·9], MC 505·5 [JC 507·1, EC 506·5], 1 F 676·15, S 2·30. (Ellis.) 1780*c*, Padua; copy made for me under the direction of Prof. Rosetti (see A 425·2 for references) of the higher old F fork preserved in the bell foundry of Colbacchini at Padua. Prof. Zantedeschi mentions an F fork there preserved as old as 1777 at least, but says he found it a semitone higher than Colbacchini's (more recent) pitch pipe. But the octave of the F of the pipe measured by me (see A 425·2), that is 2 F 343·6, is 1 F 687·2, which is very nearly the same as this fork. Colbacchini did not know which of their two F's Zantedeschi had examined, and sent me copies of both (see the other under A 403·9). Neither would agree with Prof. Zantedeschi's unfortunately inaccurate observations.

MA **422·7** [JA 421·4, EA 425·2], C 505·7, S 2·31. (Ellis.) 1800*c*, London; old fork belonging to Messrs. Broadwood.

(1) A **423·0**, MC 506·0 [JC 507·6, EC 503·0], S 2·32. (Drouet, as cited by Fr. Com.) 1810, Paris, Opera. The pitch is very probable; but as I have been unable to find the original account I do not know how it was obtained.

(2) A **423·0**. (McLeod actually 423·02; Ellis, 423·09.) 1820, France, Paris, Theâtre Feydeau, Opéra Comique; copy (compared with the original by M. Cavaillé-Coll, and found "sufficiently exact") of the original (No. 494 of Catalogue) preserved in the Musée du Conservatoire. The original is $3\frac{3}{4}$ in. from bend to point, converging prongs with a disk at end of stem, much spotted with rust, the disk being black with it; in a wooden case inscribed, "Feydeau, 1820; donné par M. Dauprat." My son measured the original as 423·06.

(1) MA **423·2** [JA 421·9, EA 425·7], C 506·3, S 2·33. (Ellis.) 1778, London; Green's organ at St. Katherine's Church, Regent's Park. A large fine organ, short octave (see MA 424·3, long keys white, still in mean tone temperament (I measured A 423·6 on the instrument, but have calculated the above pitch of A from C as most likely to be correct); pipes evidently untouched, but ill-treated in tuning; coned in and out, and often jagged at the end (the 1 C was coned out, and the 2 A coned in).

(2) EA **423·2** [MA 420·7, JA 419·4], C 503·3, S 2·33, or if taken from MA 420·7, then S 2·22. (Ellis.) 1815-21, Dresden; Band of the Opera. From a fork lent me by Frau Näke, of Dresden, contained in a box labelled, "Dresdener Kapelle, 1815-1821, c'." C. M. von Weber (1786-1826) was Kapellmeister at Dresden during this time. I have taken the EA in preference to MA, because it agrees more closely with the fork of Anton von Weber, his father (see A 424·1). The pitch of the Dresden opera began to rise in 1821, according to Näke, in consequence of the celebrated flutist Fürstenau, then using a new flute made by Koch of Vienna. But as late as 1824 it was lower than in Munich. For present pitch see A 437·8 and references.

MA **423·3** [JA 422, EA 425·8], C 506·4, S 2·33. (Ellis.) 1813, London; Original Philharmonic. This is a second copy of Peppercorn's fork (see first in MA 423·7), prepared for the Society of Arts in 1860 (now in possession of Messrs. Broadwood); but whether this or the other is the better is uncertain. The difference is only ·02 eq. sem.

MA **423·6** [JA 422·3, EA 426·1], C 506·7, S 2·34. (Ellis.) 1800*c*, London; old fork belonging to Messrs. Broadwood.

MA **423·7** [JA 422·4, EA 426·2], C 506·81, S 2·35. (Ellis.) London, 1813; Original Philharmonic. This is a copy (in the possession of Mr. Hipkins) made before 1860, of the original fork (now lost) by which Mr. Peppercorn, of Broadwood's, tuned the pianos of the Philharmonic Society, from its foundation in 1813 to 1828. Mr. Hipkins believes that this fork was settled in a consultation of Sir George Smart (conductor) with Braham (tenor), Griesbach (oboist), and Mrs. Billington (soprano, who left England in 1817). For other pitches of Sir George Smart, see A 433 and 433·2; see also MA 423·3.

A **424**, EC 504·2 [MC 507·2, JC 508·8], S 2·36. (Näke.) 1862, Germany, Dresden. Orchestra of the Roman Catholic Chapel, according to Näke, who says that, consequently, the organ can agree with it only in the hottest days of summer. If we suppose the organ to have been at A 418·1 (which see) at 59° Fahr., then temperature must rise to 72·6° Fahr., according to the usual formulæ of reduction, before the organ would agree with this orchestral pitch. When the instruments were taken to the Opera-house in 1862, for experimental performances of Mozart's operas, Näke says they rose from A 424 to A 427·5, through the mere heat of the house.

A **424·1**, EC 504·3 [MC 507·3, JC 508·9], S 2·36. (Näke.) 1740 —1812, Germany; Eutin (18 miles N. of Lübeck, in North Germany, of which principality it was capital, though surrounded by Holstein). Fork of Franz Anton von Weber, father of Carl Maria von Weber. As equal temperament was, in intention, used at this early period in Hamburg, and probably Lübeck for the very sharp organs there, I have placed EC first. Compare A 423·2. Näke's precise measure of this fork is 424·0665.

(1) MA **424·2** [JA 422·9, EA 426·7], C 507·3, S 2·37. (Ellis.) 1619, Brunswick. "Suitable" Church Organ Pitch. Praetorius ("Syntagma Musicum," vol. ii., p. 231-2) gives what he terms "a correct drawing of the proper church-pipe measure for *c'''*, or the half-foot tone of the organ-builders;" that is, $\frac{1}{2}$ C. This figure gives the dimensions of the whole octave from $\frac{1}{2}$ C to $\frac{1}{4}$ C. It is a rough woodcut, on very bibulous paper, which must have shrunk much in drying. At the back of the title of the "Theatrum Instrumentorum seu Sciagraphia," in the same volume, Prætorius gives a scale of six Brunswick inches, which, on the figure, measure 140·5 mm. in place of 142·68 mm. Dividing the latter by the former, we obtain 1·0155 as the multiplier of the dimensions of the drawing to correct for shrinkage. The actual drawing on the paper gives 133·8 mm. for the length, and 25·2 mm. for double the side of the square pipe, corresponding to $\frac{1}{2}$ C. Multiplying by 1·0155, we find 135·87 and 25·59 respectively. Doubling the first to get the 1 C, we have 271·74 mm. for the length, and 25·59 mm. for the side of the square of a wooden pipe giving this recommended pitch. I had a wooden pipe constructed which was 272 mm. long and 25·5 mm. in the side, and spoke 503·6, 507·25, and 511·86 under pressures of $2\frac{3}{4}$, $3\frac{1}{4}$, and 4 inches respectively. Correcting this (by rule Art. 8), by multiplying by 323 (= 272 + 2 × 25·5) and dividing by 322·92 (= 271·74 + 2 × 25·59), we obtain C 503·7, 507·4 respectively; practically, the same as before, the errors in length and side being in opposite directions, giving

MA 421·1, 424·2, and 428·0 respectively. As 3¼ in. was, according to Herr Schmahl (see "Authorities") almost precisely the force of wind used by Praetorius, I assume the second as most correct, and hence obtain the above figures. This is the "mean pitch," being practically the same as Handel's A 422·5, and it is the earliest example of it that I have found. It was not then the ordinary pitch, but it was, in Praetorius's mind, the most suitable. It was this pitch to which Praetorius must have referred when he said that the Halberstadt organ, A 505·8, was a good Tone, and nearly a Tone and a half sharper than the suitable church-pitch (*als die unsrige itzige Chormessige Werke stehen*). The difference of pitch was S 3·04, just an equal minor Third; and just less than S 3·103, the meantone minor Third. These two pitches, therefore, confirm each other. The lengths and sides of the other pipes in the Octave were not engraved with sufficient accuracy to draw out the exact temperament; but, as Praetorius explains how to tune in the meantone temperament, and no other (perfect major Thirds, and Fifths a quarter of a comma too small), there was no necessity to attend to the pitch of any but the lowest note, which had the longest pipe, and was, therefore, in all probability, most accurately rendered in the woodcut.

(2) **A 424·2**, EC 504·4 [MC 507·4, JC 509·0], S 2·37. (Fischer; for references and explanations, see A 437·3.) 1823, Paris; Italian Opera. Mean of 20 trials. The fork measured was 4 A 212·08, and was given by Spontini. Probably, MC should be used. I have used Fischer's V 424·17, but this requires the length of the string to be 23·721, and not 23·712, Prussian inches, as he gives it, and I consider this transposition of 1 and 2 the most probable misprint.

(1) MA **424·3** [JA 423·0, EA 426·8], C 507·6, S 2·37. (Ellis.) 1750*c*, London. Old forks, formerly belonging to the late Prof. Faraday, lent me by Mr. Blaikley, of Messrs. Boosey. The C 507·6 was clearly a common music-shop fork, giving the pitch of 1750 and later. Calculating from this JA *flat* 406·1, JE *flat* 609·1, JA 423·0, as just minor Thirds, to JF 338·4, and C, and comparing them with the forks of the set A *flat* 404·7, E *flat* 609·5, A 422·7, there seems little doubt that these were attempts at tuning the former correctly by ear. These were made for lecture purposes, most probably. The MA 424·3 is selected to take the real pitch from.

(2) MA **424·3** [JA 422·8, EA 426·7], C 507·4, S 2·37. (Ellis.) London, 1749. Glyn and Parker's Organ, at All Hallows the Great and Less, Upper Thames-stret. This firm (who lived at Salford, Manchester) were the builders of the organ which Handel presented to the Foundling Hospital, and which had probably the pitch of Handel's fork (see (1) A 422·5. The present organ is in equal temperament, and the actual pitches of A, B, C, in September, 1878, were A 426·7, B 478·0, C 507·4, which are very closely the equal temperament A 426·7, B 478·9, C 507·4. The organist (Mr. Yeatman) informs me that equal temperament has been adopted for some time, but I have adopted the old MA. The organ has no couplers, an octave of pedal keys, but no pipes, very shallow touch, a raised cornet on the great organ, a "short octave"—that is, the lowest notes are G, C, A, D on the keys which look to be B, C, C *sharp*, D; great and choir organ 4½ octaves, swell 3 octaves. The B pipe is exactly 12 in. long, and 0·95 in. in diameter. Organ inscribed, "Erected by voluntary subscription of these United Parishes, A.D. 1749." The pitch was taken from the choir organ, the C of which was exactly of the same pitch as that of the great organ. Probably owing to the residence of the builders at Salford, A. Jordan was its first caretaker. Dr. Boyce was organist in 1749.

EA **424·4** [MA 421·9, JA 420·6], C 504·7, pressure 3¼ in., S 2·37. (Ellis.) 1833, Weimar; organ. J. G. Töpfer, an organist and author of a well-known work on the organ (chiefly adapted from Bédos: in his "Orgelbaukunst," p. 41, gives for his wide principal 1 C a pipe 1 Weimar foot (= 282 mm.) long and 15·76 Weimar lines (= 30·86 mm.) in diameter. I had a pipe constructed 279·5 mm. long and 30 mm. in diameter, which spoke V 510·1, 510·7, 512·9, under pressures of 2⅞, 3¼, and 4 in. respectively. Reducing these for a pipe of the proper dimensions (see rule Art. 8) by multiplying them by 988·5 (= 3 × 279·5 + 5 × 30, and dividing them by 1000·3 (= 3 × 282 + 5 × 30·86) we obtain C 504·1, 504·7, 506·9 respectively, giving EA 423·9, 424·4, and 425·9 respectively, where I use EA, because Töpfer says that the unequal temperament had been almost entirely superseded by the equal. But the value of C belongs to the time of meantone temperament, and the three MA are 421·4, 421·9, 423·7 respectively. The middle pressure is most probably correct.

A **424·6**, MC 507·9 [EC 505·0, JC 509·5], S 2·38. (Ellis.) 1800*c*, England; old fork said to have been used at Plymouth Theatre at the beginning of 19th century, lent me by Dr. Stainer.

A **424·9**, MC 508·3 [JC 509·6, EC 505·27], S 2·39. (Näke.) 1800*c*, Germany; fork of the bassoonist Kummer, sen.

A **425·2**, MC 508·7 [JC 510·2, EC 504·5], S 2·41. (Ellis.) 1730*c* and 1780*c*, Padua; two ancient pitch-pipes belonging to the bell foundry of Colbacchini at Padua, and kindly lent to me at the request of Sig. F. Rossetti, professor of physics at the University of Padua, in order that I might verify some experiments made upon them by Prof. Zantedeschi, his predecessor (died 1873. The foundry was established in 1730, and the older pipe, which extends from 4 B to 1 F *sharp*, is believed to be of that date; but the more recent one, which extends from 4 A to 1 A, is believed to be fifty years more recent. It was the latter, with 2 octaves, which Prof. Zantedeschi had used, and he treated it as proceeding in just intonation from 2 C 256. When they came into my hands both pipes were unusable, and could not be made to give any intelligible note, so that any pitch might have been assumed for them. I put them into the hands of Messrs. Hill & Sons, the organ-builders, who softened the leathern pad at the end of the piston, and made them speak easily, without any alteration of the mouth or length, and prepared an adapter, so that both could be tried on a proper bellows. Each A was measured on two different days, and the results reduced to 59° F. The older pipe gave V 425·7 and V 426·73; the newer pipe gave V 422·2, and V 426·3; both under 2½ in. of wind, which was as much pressure as they could well bear. As there was no means of determining the pitch of such an instrument accurately, for it probably varied every time it was used, I have assumed the mean of all four measures as the possibly intended value of both A's. It was necessary to employ different pressures with the older pipe, to bring out the notes, and I always used the smallest possible. The pitches of the 2 ft. octave of the two pipes were as follows, reduced to 59° F.:—Older pitch-pipe (1½ in.) C 250·4, C *sharp* 265·6; (1⅞ in.) D 283·6, E *flat* 299·0; (2 in.) E 317·9, F 337·2; (2⅛ in.) F *sharp* 357·9, G 380, G *sharp* 403·5; (2¼ in.) A 426·7 or 425·7; (2⅜ in.) B *flat* 453·8, B 479·4, C 509·6, which is considerably sharper than the true octave 500·8 of the lower C. The pitches of the notes in the same octave in the more recent pitch-pipe are as follows: the pressure being 2½ in. throughout and * marking those pitches which were taken on the second day—C 252·13, *C *sharp* 272·4, *D 288·9, *E *flat* 304·8, E 325·6, *F 343·6, *F *sharp* 362·0, G 378·1, *G *sharp* 403·7, A 422·2, or *426·3, B *flat* 444·9, B 469·5, C 497·5, which is a good deal flatter than the true octave 504·3 to the lower C. It is evident that this was very different from a justly intoned octave to C 256, as was assumed by Prof. Zantedeschi (in his memoir on the variability of tuning-forks, "Sitz. Ber. Math. Kl. k. Acad. der Wiss." Vienna, 1857, p. 172), and that all measurements of pitch made with this pipe must have been faulty. For the forks examined by Prof. Zantedeschi see A 403·9, (2) A 422·3, (3) A 422·6, A 436·6, A 483·7. The above pitch-pipe scales should be compared with Cavedini's forks (2) A 422·3. All three were supposed to be Roman pitch of one hundred and fifty years ago, but look more like Lombard pitch. (See Art. 26, note 10.)

A **425·5**, EC 506 [MC 509, JC 510·6], S 2·42 (Lissajous, reported by de la Fage), 1829, Paris. Pitch of opera piano as distinct from the orchestra, see A 425·8 and (2) A 434, verified by Monneron for A. de la Fage.

(1) MA **425·6** [JA 424·3, EA 428·1], C 509·1, S 2·42. (Ellis.) 1740-80, England; Schnetzler's organ at the German Chapel Royal, St. James's Palace. A chamber organ, formerly at Buckingham Palace, with C untouched, but put into equal temperament, having actually A 428·4, which, as seen above, is nearly correctly EA, but I have taken the pitch from MA 425·6, as that belonged to the time when the organ was built. *Schnetzler's* name is so spelt on an organ belonging to Mr. Drew of Dublin. English books generally give *Snetzler*.

(2) A **425·6**. (Hill.) 1764, England, Halifax; one of Schnetzler's organs sharpened by Messrs. Hill & Son. The pitch is presumed to be the same as that of Schnetzler's German Chapel organ, for Mr. T. Hill said, it was "flat," and the organist Mr. Frobisher had always to transpose a semitone, in case of having to play with other instruments, at festivals.

(1) A **425·8**, EC 506·3 [MC 509·31, JC 510·9], S 2·43 (Lissajous, from de la Fage). 31 March, 1824, Paris, opera. Pitch suddenly lowered for Mdme. Branchu, whose voice was failing. The piano for rehearsals was also lowered, and was not raised immediately when the orchestra was raised. The piano was said to be of *opera pitch*. See A 425·5.

(2) A **425·8** (de la Fage). Bologna, Italy, 1839; pitch of fork used by Tadolini, the best tuner in the town, to tune A. de la Fage's piano.

MA **425·9** [JA 424·6, EA 428·4], C 509·5, S 2·44. (Tunbridge and Ellis.) 1740, England; St. George's Chapel, Great Yarmouth, retaining the original pitch, though put into equal temperament in 1840; built by Byfield, Jordan, and Bridge. The pitch of C was measured by beats with a fork counted by the organist Mr. T. Tunbridge, and the fork subsequently measured by me. The organ had originally a short octave (see (2) A 424·3), but it had no quarter tones, as has been reported.

(1) A **426·5**, MC 510·2 [JC 511·8, EC 507·2], S 2·46. (Delezenne, as cited by de la Fage). 1800*c*, Germany (?); a flute by Holtzappel, bought in 1805. See Delezenne's observations under (2) A 418.

(2) MA **426·5** [JA 425·0, EA 429·0], C 510·14, S 2·46, pressure 2⅞ in. (Ellis.) 1843, England, Wimbledon Church, built by Messrs. Walker; from a pipe preserved by them.

A **427·0**, EC 507·7 [MC 510·8, JC 512·3], S 2·48 (Scheibler, "Tonmesser," p. 52, No. 1, gives A 426·75 at 69° F, here reduced to 59° F.) 1811, Paris, Grand Opera. Scheibler does not trust it so much as A 434·0. A. de la Fage gives the date 1811, but cites the pitch as A 426·735.

(1) MA **427·2** [JA 425·8, EA 429·7], C 511·0, S 2·49. (Ellis.) 1878*a*, Norwich. Organ of Norwich Cathedral as it was in the mean-tone temperament before it was altered by Messrs. Bryceson in that year, measured from a pipe tuned as the octave below a ½ C pipe, just brought from the organ by Messrs. Bryceson, and cleaned. In June, 1877, Dr. Buck, who was then organist, tuned a fork to it, which I measured it as A 431·6; but the temperature was not stated, and probably may have been high, since 69° F. would give the same pitch as above. The building of the organ is attributed to Renatus Harris, though an open diapason was added by Byfield. The organ had been much altered at

various times, but it apparently retained the pitch R. Harris used at St. Andrew, Undershaft, London. (See A 427·7.) The little pipe measured seemed to be quite untouched. The pitch has now been somewhat raised by Messrs. Bryceson. It was intended to be raised to French pitch, but from the state of the pipes it was found necessary to make it higher.

(2) MA **427·2**. (Ellis.) 1825 *c*, London; old fork belonging to Messrs. Broadwood. See (2) A 427·5.

(1) A **427·5**, MC 511·4 [EC 508·4, JC 513], S 2·50. (Lissajous, from de la Fage.) 1800 *c*, London; old fork in possession of Adrien de la Fage in 1859.

(2) MA **427·5** [JA 426·2, EA 4·30], C 511·4, S 2·50. (Ellis.) 1826 *c*, London; old fork belonging to Messrs. Broadwood.

(3) A **427·5**. (Näke.) 1862, Dresden Church Orchestra, when transferred to the theatre. See A 424.

(4) JA **427·5** [MA 428·8, EA 431·4], C 513, S 2·50. (Ellis.) 1877 *a*, London. Standard fork of the Tonic Solfa College up to 1877. It had been intended for 512, and obtained from the siren and Koenig's fork, which is 512·55. But finding that it measured 517·8 by Appunn's tonometer, Mr. Curwen, the president of the College, resolved to adopt Appunn's 512 as his standard. This would be about 508, and would be as nearly as possible JC to Handel's pitch (see A 422·5). as it would give JA 423·4. Actually the forks sold are often C 507, which is exactly JC to Handel's A. As the Tonic Solfaists sing in just intonation, JA is used above for the determining pitch.

A **427·6**, EC 508·5 [MC 511·5, JC 513·1], 2 A 218·8, S 2·50. (Fischer, for references and explanations see A 437·3.) 1823, Paris, Theâtre Feydeau, or Opéra Comique; fork given by Spontini, mean of 20 trials. Probably mean temperament is more correct. By a typographical error in his abridged table, p. 211, Fischer gives the pitch as A 408 in place of A 428, and this had misled Bindseil and probably others.

MA **427·7** [JA 426·4, EA 430·5], MC 511·7 [JC and EC the same], 2 G *sharp*, 399·74, S 2·51. (Ellis.) 1696, London; old organ of St. Andrew, Undershaft, built by Renatus Harris. The pipe measured was a G *sharp*, the double octave major Third of 8 E, marked *Tee*, a solitary pipe preserved by Messrs. Hill and Sons when they rebuilt the organ. This is considered as the just major Third of E, and as E is of C, in accordance with the meantone temperament. This gives MC identical with JC, and this C is taken as the starting point for equal temperament also, and then the other pitches were calculated as above. The pipe had no ears, and the upper lip was slightly arched. (See MA 434·7.

A **427·8**, MC 511·8 [JC 513·4, EC 508·7], S 2·51. (Ellis.) 1788, Windsor Castle, St. George's Chapel, made by Green, and presented by George III. It has evidently been sharpened through trimming. (See (2) A 422·6.) On 10th February, 1880, I measured A 427·8, B 478·6, C 511·5, at 59° F. Calculations from the measured A, assuming meantone temperament, we should have B 478·3, C 511·8; calculating from the measured C. we should have had A 427·6, B 478. Hence the A, B, C, were very accurately in meantone intonation, as was intended.

MA **428·4** [JA 427·2, EA 431·0], C 512·5, S 2·54. (Ellis.) 1826, London; old fork belonging to Messrs. Broadwood.

(1) MA **428·7** [JA 427·3, EA 431·2], C 512·8, S 2·55. (Ions.) 1670, St. Nicholas, parish church of Newcastle-on-Tyne, built by Renatus Harris. It has been frequently improved and added to, but the pitch does not seem to have been altered (see A 427·7 with which it is practically identical). "It has been tuned in equal temperament since 1842, when it was altered for the Grand Musical Festival of that year. Sir George Smart then complained of the lowness of the pitch, and several of the orchestra found it difficult, if not impossible, to tune to it. Mr. Nicholson, the organ-builder, who made the change, is still living, and he says that C was not altered by him." Letter from Mr. W. J. Ions, the organists, who took the pitch by beats with a fork measured by me, at a known temperature, here reduced to 59° F.

(2) A **428·7**, MC 512·8 [EC 509·8, JC 514·4], S 2·55. (Delezenne, 1800*c*, Lille.) Fork in the possession of the family of M. Cohen for more than 50 years before 1854. The case is of an ancient form.

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5. The Compromise Pitch.

A **430·0**, MC 514·4 [JC 516, EC 511·35], S 2·60. (Lissajous, "Bull. Soc. Encour.," liv. 1865.) 1810*c*, Paris; fork belonging to a celebrated amateur, M. Lemoine, acquainted with all the principal artists, and head of an institution. A. de la Fage supposed it was intended for EA to C 512. In that case it was merely a fancy fork at that period.

MA **430·3** [JA 427·6, EA 432], MC 514·8 [JC 513·2, EC 513·8], 2 G 384·9, S 2·62. (Ellis.) 1826 *c*, London. Old G fork, formerly belonging to Faraday, lent by Mr. Blaikley, of Messrs. Boosey's. An isolated fork, and apparently intended for JG 384 to C 512. If, however, we take meantone temperament, we have almost exactly the pitch of Fulham Parish Organ before it was put into equal temperament (see A 430·4); so it may have been simply a music-shop G of about 1826.

MA **430·4** [JA 429·1, EA 433·05], C 514·87, S 2·62. (Ellis.) Fulham Parish Church organ, built by Jordans, 1701, but tuned to equal temperament by H. Jones, 136, Fulham-road, about 1858, who does not remember altering the pitch. I have therefore arranged it under meantone temperament. On measuring I find EA 433·8 tolerably correct, and EB 486·9, each nearly ·8 vib. too sharp. The pitch may be that of Gray and Davison, who had it in hand 1830, as the pitch belongs to that period.

A **430·5**, EC 512·0 [MC 515·0, JC 516·6, S 2·62. (Wieprecht, cited by French Commission.) 1806-14, Berlin, Opera. The original statement by Wieprecht has not been found. The pitch may have been C 512, whence the French Commission calculated at EA 430·5, which may have been right, but the date implies MA 428 (whence S 2·52) and JA 426·7. The pitch is therefore doubtful, A. de la Fage says that Marloye proposed this 2 A as a standard, which amounts to selecting 1 C.

A **430·8**, EC 536·4 [MC 539·6, JC 541·3], S 2·63. (Drouet in French Commission.) 1830. France, Paris Opera. The original account has not been found.

(1) A **431·7**, EC 513·4 [MC 516·4, JC 518], S 2·67. (Fischer, for reference and details see A 437·3.) 1826, Paris Grand Opera. The fork, which measured V 215·85 was given to Fischer by Spontini. The vibrating length of string used was the mean 30 experiments. By an error of calculation Fischer gives the pitch as 431·36, and consequently, in his table, p. 211, where he only gives the pitch to whole numbers, he gives it as A 431 in place of A 432. Or if his result is right, then the length of his wire was 23·164 Prussian inches, in place of 23·307 as he gives it.

(2.) MA **431·7** [JA 430·3, EA 434·2], C 516·4, JE 322·8, S 2·67 (Ellis.) 1826*c*. London. Old forks formerly belonging to Prof. Faraday, lent by Mr. Blaikley of Messrs. Boosey's, compare MA 424.3. The C is apparently a music-shop fork of the transition period, see A 433·2, to which the E was tuned correctly as JE below.

A **432**, PC 512 [EC 513·7, MC 516·8, JC 518·4], S 2·75. (Meerens.) 1876, Brussels. In a paper presented to the Institute of Geneva, 21st of October, 1876, and printed separately, as "Mémoire sur le Diapason" (Brussels, 1877), M. Ch. Meerens proposes this as a standard, from a paper by M. Elie Ritter in vol. viii. of "Trans. of Inst. Gen.," where M. Ritter, bases the choice on 432 being a multiple of 2 and 3. M. Meerens takes it as the PA to C 512, as it would be tuned on a Viola having 4C 128, 4G 192, 2D 288 and 2A 432, and considers that this is the only proper A to the tonic C 512, inasmuch as the JA 426⅔ belongs to the tonality of F 341⅓. This again depends upon his peculiar view of the scale, which does not allow the scale of C to be composed of four notes, forming three perfect Fifths, as F, C, G, D, and the major Thirds to the three first, A, E, B. But composes it of the four notes C, G, D, A, forming perfect Fifths, and E, B, the major Thirds to the first notes, C, G, and the minor Third F to the third note D. The notes F and A in this case are then a whole comma higher than in the former. In this scale the subdominant chord chord, F, A, C, would be a strong dissonance, and consequently no written music using that chord would be endurable on his scale. I am not aware that this standard has ever been used.

A **432·2**, EC 514·0 [MC 517, JC 518·6], S 2·69. (Delezenne.) Lille, 1854*a*. Organ of St. André, repaired, and probably retuned to the chamber pitch of the time. It is exactly one tone higher than St. Sauveur at Lille, see A 584·6. Temp. not stated.

MA **432·3** [JB 431, EA 434·9] C 517·2, S 2·70. (Ellis.) 1846 *c*, London. Old fork in possession of Messrs. Bryceson, organ-builders, which belonged to their father, and had not been tuned for more than 30 years before 1878, but it had been unwillingly sharpened a little before that time. It probably shews the rise in the Philharmonic pitch then made (see A 433·2) which Mr. Bryceson, senior, seems to have objected to.

MA **432·6** [JA 431·3, EA 435·2], 2C 258·77 (517·54), S 2·71. (Ellis.) 1846 *c*, London. Old fork bought by me about 1863 (see A 433·7), and hence I reckon pitch by meantone temperament.

MA **432·8** [JA 435·4, EA 435·4], C 517·8, 1 E 647·2, S 2·72. (Ellis.) 1826 *c*, London. Old forks formerly belonging to the late Prof. Faraday, lent by Mr. Blaikley, of Messrs. Boosey. The C was nearly correctly Sir G. Smart's (see A 433 and 433·2), and the E was perfectly tuned as a just major Third above.

A **432·9**, MC 517·8 [EC 514·7, JC 519·4], S 2·72. (Delezenne.) Cited as an "old fork" in Delezenne's table, 1854, without further specification.

MA **433** [JA 431·7, EA 435·6], C 518, S 2·72. (Ellis.) 1826, London. Fork approved of by Sir George Smart, conductor of the Philharmonic, in possession of Mr. Hipkins. This seems to have been a second fixing (see MA 423·7.) This was in general use in the shops as the London Philharmonic from 1840 to 1846, but it was not the pitch of the Philharmonic at that time. The mean temperament is employed because it was the only one used by Sir G. Smart. If equal temperament is used, this C 518 (see A 433·2) gives practically modern French A 435·4, which was thus anticipated by 30 years in England, and is found on many restored organs. Used in this way, it is Broadwood's lowest pitch, and is London No. 1 of the French Commission of 1860, where the report gives it as A 434, which is much better than for No. 2 and No. 3 (see A 445·5 and 452·5.) Another copy prepared for Society of Arts in 1860, gives C 517·72, which is still nearer to modern French pitch.

(1) A **433·2**, MC 518·2 [JC 519·8, EC 515·1], S 2·73. (Ellis.) 1820 *c* (according to Mr. Hipkins), London. Sir George Smart's own Philharmonic fork, left by him to the late Mr. John Black, and now in the possession of Mr. Algernon Black; the original fork was in a well-worn plaid silk case. This pitch was adopted, after a consultation, as a kind of standard, and was used as such by organ-builders. Sir G. S. considered that this

fork agreed with the C 518 given under A 433, which proves that he used the mean tone temperament. To this pitch Mr. C. A. Bishop tuned the Temple and St. Paul's organs (see end of remarks A 422·5).

MA 433·5 [JA 432.1, EA 436], C 518·52, S 2·74. (Ellis.) 1846 *a*, London. This is the same fork as is entered under (2) EA 436, for the reasons there stated.

(1) **MA 433·6** [JA 432·3, EA 436·2], C 518·8, S 2·75, pressure 2½ in. (Ellis.) 1830 *c*, Ireland, Belfast, Christ Church. Date conjectured from pitch which, may have been altered between 1820 and 1850. From a pipe at Messrs. Walker's organ works.

(2) **MA 433·6**, C 518·8 (Byolin and Ellis, Shrewsbury, St. Mary's, originally built by Byfield and Green; pitch probably altered by Messrs. Gray and Davison, 1840 *c*. Pitch of C measured by the organist, Mr. Byolin, by means of a fork measured by me, and then reduced. The organ is still in meantone temperament.

MA 433·7 [JA 432·3, EA 436·2], C 518·77, S 2·75. (Ellis), 1846c, London. Old fork bought in London, at the same time with C 258·77 (see MA 432·6) of which it apparently was meant to be the Octave. Belongs to A 433·2, hence pitch is reckoned from MA.

A 433·9 EC 516·0 [MC 519·0, JC 520·7], S 2·76. (Scheibler, "Tonmesser," No. I, 433·8 at 69° F, here corrected for temperature.) 1834c. Vienna orchestra, fork belonging to Scheibler or his friends. This is the lowest of the Vienna forks cited by Scheibler, and is apparently that referred to as "Vienna minimum" by Delezenne, who gives only A 433, and also cited as a minimum by de la Fage, who gives the right number.

(1) **A 434.** EC 516·1 [MC 519·2, JC 520·8], S 2·76. (Cagnard de la Tour, from Cavaillé-Coll, "du Ton Musical," p. 13). 1819, Paris. No other particulars given.

(2) **A 434** EC 517·31 [MC 519·18, JC 520·8], S 2·76. (Cagnard de la Tour from de la Fage.) Paris, 1829; opera. Fork verified at the time by M. Montal, piano maker. This was after the orchestra of the opera had recovered its pitch (see A 425·8), which is said to be due to the cornist, Jean Mengal, having quietly shortened his horn. The opera piano remained at the low pitch (see A 425·5).

(3) **A 434 0.** EC 516·1 [MC 519·1, JC 520·8], S 2·76. (Scheibler, Toumesser, p. 52; No. 2, given as A 433·75 at 69° F., here corrected to 59° F.) 1834 *c*, Paris, opera. Fork made by Petitbout, luthier de l'opéra, and trusted by Scheibler, because he knew the maker to be skilful.

A 434·3. MC 519·5 [JC 521·2, EC 516·5], S 2·78. (McLeod and Ellis.) 1818, France, Paris; organ of the Chapelle des Tuileries. Copy (compared with the original by M. Cavaillé-Coll, and found "sufficiently exact") of a fork (No. 493 of the catalogue) preserved in the Musée du Conservatoire. The original is of the same size and shape, down to the conical brass cup, as (1) A 439·5. The mean pitch of the fork, as measured by my son, was A 434·4. Label attached, "Chapelle Royale, No. 3." There are a few spots of rust, but no stamped marks or letters. This was evidently tuned to the pitch of the opera of the time (see A 434, (1) and (2).

A 434·5. EC 516·7 [MC 519·8, JC 521·4], S 2·78. (Ellis.) 1869, Germany, Baden. Fork sent officially to the Society of Arts, and lent to me. Intended for diapason normal (see A 435·4).

MA 434·7 [JA 432·1, EA 433·0], MC 520·1 [JC 518·5, EC 515·0], B *natural* 486·1, 3¼ in. pressure, S 2·79. (Ellis.) Experimental pipe to represent All Hallows, Barking, built by Renatus Harris. The 2 B *natural* of this organ had, as I was informed by Mr. Hill, a pipe 12 in. long and 1 in. in diameter. I had a pipe made 12 in. long and ·95 in. in diameter, which spoke V 486·9, 488·7, and 490·5 at 2¾, 3¼ and 4 in. pressure. Correcting according to the rule in Art. 8, by multiplying by 49·75 ($= 3 \times 12 + 5 \times 95$), and dividing by 41 ($= 3 \times 12 + 5 \times 1$), there result B *natural* 483·9, 486·1, 487·5, giving MA 432·8, 434·7, 436·0 respectively. Selecting the second as most probable, we obtain the above figures. It is, however, not unlikely that this pitch may have been sharper than that of the real organ. Compare the copy of B Schmidt's pipe (1) A 445·8, and compare A 427·7 for Renatus Harris's St. Andrew's, Undershaft, which is more probably correct. Perhaps the cause of the difference lay in the mouth of the pipes, which in Harris's is very peculiar and arched.

(1) **A 435·0.** EC 517·3 [MC 520·4, JC 522·0], S 2·80. (Näke.) 1826, Germany, Saxony, Dresden, Opera. Tuning fork of Kapellmeister Reissiger, successor to C. M. von Weber. Näke considers this to have been the Dresden pitch from 1825 to 1830.

(2) **A 435·0.** (Cagnard de la Tour, from de la Fage.) Paris, 1829; Italian Opera.

(3) **A 435.** (Ellis.) 1849 *a*, London; old fork long in possession of a gentleman in Ireland, marked "Philharmonic;" date conjectural, evidently of Sir George Smart's time (see A 433·2). The fork was very bad, and did not beat uniformly for four seconds, so that the pitch was only approximately determined by a unison.

(4) **A 435.** (Fr. Com.) 1859, Carlsruhe Opera. M. Jos. Strauss, Kapellmeister at Carlsruhe, informed the French Commission that this pitch fatigued his singers, both male and female, the least, and is best adapted for the execution of operas, both ancient and modern. The French Commission was often taunted with adopting as its pitch that of a tuning fork which the Carlsruhe Kapellmeister pulled out of his pocket; but reference to the pitches in this table, from A 433·5 to A 437, of about 1830 and earlier, will shew that A 435 or thereabouts, was a pitch very much used 30 years and more before the French Commission was appointed.

(5) **A 435·0.** (Näke.) 1862, Austria, Vienna Opera; from an oboe of Prof. Sellner in Vienna. (See Delezenne's remarks under (2) A 418.)

(6) **A 435·0.** (Ellis.) 1860, Paris, Koenig's Diapason Normal; from copy in possession of Dr. Stone. This is what the diapason normal was intended to be.

(7) **A 435·0.** (Ellis.) 1877, Paris; copy of the Diapason Normal by Secretan, in the possession of Dr. W. H. Stone.

(8) **A 435·0** (Ellis.) 1877, Paris; copy of Diapason Normal, Modèle d'Orchestre, by Secretan, in my possession; actual measure, A 434·97.

A 435·2. EC 517·5 [MC 520·6, JC 522·2], S 2·82. (Scheibler's "Tonmesser," p. 53. No. 3, given as A 434·95 at 69° Fahr., here corrected to 59° Fahr.) 1834 *a*, Paris, Conservatoire, Concerts and Italian Opera; fork made by Gand, luthier du Conservatoire, Rue Croix des Petits Champs, which Scheibler trusted because he knew the maker to be skilful.

(1) **A 435·3.** EC 517·6 [MC 520·7, JC 522·3], S 2·82. (Older fork given as A 435·05 at 69° Fahr. Scheibler, "Tonmesser," p. 53, and here corrected to 59° Fahr.). 1834 *a*, Paris Conservatoire; an oldish fork to Scheibler, in 1834, and not trusted as much as Gand's A 435·2, from which it does not differ perceptibly. Cited by de la Fage as *Violons Gand*, 1834, as if from Scheibler, who says nothing of the kind.

(2) **A 435·3.** EC 517·7 [MC 520·7, JC 522·4], S 2·82. (Ellis.) 1859, Paris; copy of the Diapason Normal made by Secretan, and presented by the French Commission officially to Messrs. J. Broadwood and Sons, lent for measurement by Mr. Hipkins. (See A 435·4.)

A 435·4. EC 517·8 [MC 520·9, JC 522·5], S 2·82. (Ellis.) Paris, 1859; the French Diapason Normal as actually constructed for the French Commission by Secretan, and now (1880) existing in the Museum of the Conservatoire at Paris. It was constructed under the direction of Lissajous, and its pitch was determined by the Siren, as driven by Cavaillé-Coll's bellows of constant pressure. The actual pitch has been arrived at thus: M. Cavaillé-Coll measured the Diapason Normal by his copies of Scheibler's forks, of which the first was probably in unison with a fork which he tuned for me to represent V 440, but was really V 439·59. Now, he made the diapason normal 4·125 flatter than this; result, A 435·465. He may, however, have made it ·875 vib. above a fork of nominally V 435, which he sent me, and which was really 434·44 vib. This gives A 435·315 for the diapason normal. In the summer of 1878 my son took beats between the diapason normal and four other forks since measured, and the mean of 30 observations gave A 435·53. In the same year Mr. Hipkins found the diapason normal make 4·1 beats with a fork measured as V 439·5; this gives A 435·4, and is the mean of the other three. The following copies of the diapason normal were made by Secretan:—

	Measures.
For Berlin, sent to the Society of Arts in 1869 ...	435·5
Bought in Paris by Society of Arts	435·5
For French Commission, 1859, and given to Broadwoods	435·3
For French Exhibition, 1867, and given to Broadwoods	435·5
For Baden (dukedom), evidently too flat	434·49
For A. J. Ellis, "Modèle d'Orchestre"	434·97
For A. J. Ellis, a second copy, larger, and made with more care	435·79
In possession of Dr. W. H. Stone	434·95
Mean of 7 of these 8 forks (excluding Baden) ...	435·36
A (poor) Munich fork, stamped as correct at the Royal Office, and sent to the Society of Arts in 1869	435·03
A (fine) Russian fork made at St. Petersburg, and sent to the Society of Arts in 1869	435·74
Fork made by Koenig	434·55
A copy by Goumas, obtained for Covent Garden Opera, 1880	435·49
General mean of 11 of these 12 forks (excluding Baden)	435·34

Hence there is room for hesitation between 435·3 and 435·5, and I assume their mean, A 435·4, as due to Mr. Hipkins, armed with an excellent fork made by Kammen, and to the probable observations of M. Cavaillé-Coll. The original fork is in perfect condition, gilt but not burnished, $4\frac{1}{16}$ in. from bend to extremity of prong, parallel prongs, mounted on resonance box, but inverted with the box uppermost, and the stem fastened to the top cross bar of a lyre, the strings of which are imitated by the prongs, furnished with two hammers with keys, one to strike and the other to damp, the whole under a glass case; the sound is very powerful. It has the maker's name, "Secretan," on one side, and on a brass plate on the stand is "Diapason Normal, 870 vibrations par seconde à la température de 15°." A second brass plate below has, "Arrêté Ministériel, en date du 16 Février, 1859. S. E. Monsieur Achille Fould, Ministre d'état." Thus preserved, it is the only authentic standard of pitch in the world, and like other standards, as those of length and weight, must be taken for what it is, not for what it was intended to be. The excellent forks of Koenig's are private

property, and may in various ways become injured (one I know has been so injured), but this standard is public property, is well guarded from injury, is perfectly accessible, and no other country has anything similar.

(1) A **435·5**, EC 517·9 [MC 521·0, JC 522·6], S 2·82. (Ellis.) 1869. Berlin Opera. Copy of the Diapason Normal, made by Secretan, and sent officially to the Society of Arts to represent the pitch then used; lent for measurement. (See A 435·4.)

(2) A **435·5**. (Ellis.) 1867, Paris. Copy of the Diapason Normal, made by Secretan, and presented officially to Messrs. J. Broadwood and Sons by the Commissioners of the French Great Exhibition of 1867. (See A 435·4.)

(3) A **435·5**. (Ellis.) 1869, Paris. Copy of the diapason normal, made by Secretan, and purchased by the Society of Arts; lent for measurement. (See A 435·4.)

(4) A **435·5**. (Ellis) 1880. Copy by P. Goumas and Cie., of the French Normal obtained by the Covent-garden Opera in January, 1880, in order to reduce the orchestra to French pitch for the approaching season. The fork could scarcely ever be counted for more than 4 sec.

MA **435·6** [JA 434·2, EA 438·2], C 521·0, S 2·82; pressure, 3 in. (Ellis.) 1830 *c*, England; Arundel Parish Church. The date is conjectural, corresponding to the pitch, which may have been raised between 1820 and 1850. Measured from a pipe at Messrs. Walker's.

A **435·7**, EC 518·2 [MC 521·2, JC 522·8], S 2·83. (Ellis.) 1869, Russia; St. Petersburgh. Russian copy of the Diapason Normal, sent officially to the Society of Arts, to represent the pitch then used in St. Petersburgh. A fine large fork. (See A 435·4.)

(1) A **435·8**, EC 518·2 [MC 521·3, JC 522·9], S 2·83. (Drouet, from de la Fage.) 1830, Paris, opera. This is probably only another measurement of the pitch, taken as A 434 by Caguard de la Tour.

(2) A **435·8**. (Ellis.) 1878, Paris. Large copy of the Diapason Normal, made for me by Secretan, who was charged to correct it by the original. It has been subsequently tuned correctly by myself. (See A 435·4.)

(1.) A **436·0**, MC 521·6 [JC 523·2, EC 521·6] S 2·84. (Sarti, maître de Chapelle to the Emperor; paper sent in 12th of May, 1796, in "Nova Acta Acad. Sci. Petr.," tom. xiii., 102, p. 30.) 8th of October, 1802, St. Petersburgh, opera. Successful experiments were made before the academy this day, with the two five-foot organ pipes (the Russian foot is the same as the English), with separate bellows and stops, a monochord and seconds pendulum. The pitch of the pipes could be altered by a small slit near the top, which could be wholly or partially closed by a slide. It was found, by help of the monochord, that when the beats of the pipes were one in a second, the pitch of the pipes was as 100 to 99, and hence as the difference was 1, the pitches of the pipes themselves were 100 and 99. When comparing these tones again with the 2 A of a violin in the St. Petersburgh band, also by means of the monochord, the 2 A was found to be A 436. Now, here we have at last three unisons to determine with the monochord and several lengths to measure. It is therefore impossible that the result should be accurate. An organ pipe five Russian (English) feet long, and four inches in diameter will produce V 100·4, according to Cavaillé-Coll's rule, Art. 8, note 5. Chladni speaks of this pitch as being very high. ("Akustik," p. 34).

(2) EA **436·0** [MA 433·5, JA 432·1], C 518·52, S 2·84, (Ellis.) 1846 *p*, London. Copy, belonging to Mr. Hipkins, of an old fork bought by Mr. E. Greaves, tuning-fork maker of Sheffield, at the shop of Bates, the organ-builder of Ludgate-hill, and marked "Philharmonic." It has not since been retuned, and it now forms Mr. Hipkins's vocal pitch. As Broadwood's have used equal temperament since 1846, this is here entered under EA 436, but, when bought, it belonged clearly to mean temperament, being evidently a commercial copy of C 518, see MA 433, and A 433·2, and hence it is also entered under MA 433·5, as it belonged to mean temperament before 1846, and to equal temperament afterwards. It was the Philharmonic Pitch with which Mr. Hopkins compared the organs of Lübeck, Hamburg, and Strasburg ("The Organ," Chap. 38, ed. 1870), as I have ascertained by measuring his fork. Bates, the organ-builder, lived near the spot where the railway crosses the bottom of Ludgate-hill.

(3) EA **436·0** [JA 432·1, MA 433·4] C 518·5, S 2·84. (Ellis.) London, 1878. Messrs. Bishop's standard for church organs, taken from Metzler's fork, representing the EC to French Diapason Normal, see A 435·4.

(1) A **436·1**, EC 518·6 [MC 521·7, JC 523·3] S 2·85. (Ellis.) 1869, Munich. Copy of the Diapason Normal made and stamped at the Government Office at Munich, sent officially to the Society of Arts to represent the pitch then used, see A 435·4.

(2) A **436·1**, EC 518·6 [MC 521·7, JC 523·3] S 2·85. (Ellis.) 1878, London. Fork, in the possession of Messrs. Bryceson, to which they tuned the organ at Her Majesty's Theatre, Italian Opera. Meant for French pitch reduced a few years ago. See (2) A 445·5, and (2) A 444·9.

A **436·5**, EC 519·1 [MC 532·2, JC 523·8], S 2·86. (Scheibler, "Tonmesser," p. 53, No. II. given as A 436·33 at 69° Fah., here corrected to 59° Fahr.) 1834 *c*, Vienna Opera. Fork belonging to Scheibler or his friend.

MA **436·6** [JA 433·9, EA 438·4], MC 522·3 [JC 520·5, EC 521·3], 4 G 195·26, S 2·87. (Ellis.) 1790 *c*, Padua. This was a copy made for me under direction of Prof. Rossetti from Stratico's fork (Zantedeschi's No. 2) at Padua, see A 425·2 and A 483·7, for references, and was inscribed *ol* for *sol*. Zantedeschi supposes that it was originally V 192, and that it had become about V 200, which he considers to represent an increase of about a semitone. But a semitone higher than V 192 is about V 203·5. The real difference between this G 195·2 and the high 1 G 865·1 (of A 483·7), or when reduced to the same octave G 390·53 and G 432·56 is S 1·77, not quite a tone. It is uncertain whether this fork was taken from an actually used pitch.

A **436·7**, EC 519·3 [MC 522·4, JC 524·04], S 2·87 (Delezenne.) 1845, Florence, opera.(?) Fork obtained and sent to M. Delezenne by M. Marloye.

MA **436·8** [JA 435·4, EA 439·4], C 522·5, S 2·87. (Ellis.) 1740-80. Green's Organ in the refectory of Trinity College, Dublin. But as Green's usual pitch was C 506·3, see (1) A 423·2, this was probably sharpened about Sir G. Smart's time, see A 433·2. It has not been sharpened by Telford, who has had charge of it since 1843, and says that it could only have been sharpened by Ferdinand Weber.

A **436·9**, EC 519·6 [MC 522·7, JC 524·3], S 2·88. (Ellis.) 1869, Würtemberg. Fork sent officially from Stuttgardt to the Society of Arts, as representing "the pitch usually adopted" in Würtemberg. It was stated at the same time that "there is no officially prescribed pitch in that country, although the new French is commonly in use;" so that this may be, after all, an imperfect copy of the French Diapason Normal. (See A 435·4.)

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6. *Modern Orchestral Pitch, and Church Pitch, Medium, marked* (*).

(1) A **437·0**, EC 519·7 [MC 522·8, JC 524·4] S 2·88. (Cagnard de la Tour, from de la Fage.) 1836, Paris Italian Opera.

(2) A **437·0**. (Fr. Com.) 1859, France, Toulouse; Conservatoire, See the Theatre, A 442·5, which is about a comma higher; the Fr. Com. says a quarter of a tone, and considers the difference remarkable, because Toulouse is a very musical place, with good singers. It also states that young singers here trained often found much difficulty, and even suffered a perceptible deterioration of voice, on exchanging their low pitch for the high pitch of Paris, then A 445·8 to A 446·2.

*(1) MA **437·1** [JA the same, EA 440·6], MC 522·9 [JC 524·6, EC 524·58], 2 F 349·72, S 2·89. (Ellis.) England, 1666; Worcester Cathedral Organ, built by Thomas and Renatus Harris. This pitch is rather uncertain. It was measured from an original show-pipe belonging to Messrs. Hill and Sons, who rebuilt the old organ in 1842. Being a show-pipe, it was much too long, and holes had been cut behind to bring it to pitch. This part of the pipe had been broken off, and the pipe in this state measured V 361 at 57° F, or V 362 at 59° F, giving MA 452·5, which would have been exceedingly sharp. To imitate the shading effect of the piece cut off, which Mr. Hill's voicer estimated would reduce the pitch by $\frac{2}{3}$ of a tone, a roll of paper was put on at the end, nearly two parts round, and then the result was as above. But very probably the pitch was thus lowered too much, and it is much more likely that the pitch was B. Schmidt's (see A 441·7.) If we suppose this to be the case, and that Thomas Harris, sen., who built the organ of Magdalene College, Oxford, used the same pitch, then R. Harris's proposal to reduce this last organ by "half a note" (see Rimbault's "Hist. Org." ed. 1870, p. 120) would mean to reduce it from a B *flat* foot organ to a B foot organ, which was R. Harris's own pitch (see A 427·7.) It would also show that B *flat* foot organs existed in England before B. Schmidt's time. It is very probable, however, that this may have been an A foot organ, see A 474·1, but then the pipes must have been shifted. The Magdalene organ may have also been A 474·1, and then R. Harris's proposal would have been to shift the pipes and make it A 441·7. The pitch of Messrs. Hill's organ in 1878, according to Mr. Done, the organist, as communicated to Mr. Hipkins, was C 532 at 66° Fahr., that is, at 59° Fahr., C 528·13, EA 444·1.

(2) A **437·1**. (Delezenne.) Lille, 1841. Organ of St. Etienne, which had been completely rebuilt in this year, and hence this was probably the pitch of the period.

(1) A **437·2**, MC 523·0 [JC 524·6, EC 519·9], S 2·89. (Ellis.) London. Old fork, formerly belonging to the late Prof. Faraday, lent by Mr. Blaikley, of Messrs. Boosey. This seems to have been merely a music-shop fork. There was no second fork tuned in accordance with it.

(2) A **437·2**. (Ellis.) London. Old fork, stamped A Philharmonic, but rather sharp for its apparent date.

A **437·3**, EC 520·1 [MC 523·1, JC 524·6], 4 A 268·65, S 2·89. (Fischer, Abhandl. Akad. Wiss., Berlin, 1822 and 3, p. 206.) 1822, Berlin; from a fork furnished by Kammermusikus Pichler, who tuned the piano for the great theatre. A vertical wire, stretched by a constant weight, was limited by a bridge till it sounded in unison with a certain fork. Of course, the stretching weight should be increased by the length of the string below the limiting bridge and the constant weight; but this was not regarded. This neglect is one element of uncertainty. The thickness of the wire necessary to support 480 Prussian Loth = 247·46 English ounces, is another source of error. Delezenne thinks that all Fischer's determinations may be V 5 too flat from this cause alone (see A 431·7, 424·2, and 427·6). The string sounded only three or four seconds, so that the unison was very difficult to seize, experiments had to be made at night, and much practice was required. By

dint of great care, the difference between the least and greatest lengths was reduced, under favourable circumstances, to ·03, and unfavourable, to 0·5, Prussian or English inch. The value in the present case was the mean of 30 trials. Fischer, however, reckons that he cannot be more than one simple vibration wrong in any case, and, in this case, not more than 0·1 vibration. In Fischer's memoirs there are curious misprints. His constant $= \frac{1}{2}$ (log 375 + log 50 + log 480 — log ·0889) $= \frac{1}{2} \times 8{\cdot}0053407$, and he has accidentally only divided the characteristic, and printed 4·0053407 in place of 4·0026703; but the calculations are made from the correct value. See the formula Art. 13, note 6. The present pitch is high, and I have reckoned equal temperament, as that was used early in the North of Germany (see A 489·2).

A **437·4**, EC 520·2 [MC 523·3, JC 524·9], S 2·89. (Delezenne.) 1854*a*, Paris; opera. Four forks, purchased before 1854, by Delezenne, and found in unison; a fifth fork, not in unison, was rejected. There is no other authority for this pitch.

A **437·5**, EC 520·3 [MC 523.4, JC 525·0], S 2·90. (Naeke.) 1823, Vienna. Performance of Weber's Euryanthe.

*EA **437·7** [MA 435·1, JA 433·8], C 520·5, S 2·91. (Ellis.) England; Great Yarmouth Parish Church, built by Byfield, Jordan, and Bridge (see MA 425·9), after it had been equally tempered by Messrs. Hill and Son, and "trimmed." Probably the old C was C 509·5, and it was certainly then in meantone temperament. From a fork sent me by the organist, Mr. Henry Stonex, which was said to beat so slowly that the beats could not be counted. This organ never had any quarter tones as reported.

A **437·8**, EC 521·8 [MC 523·1, JC 525·4], S 2·91. (Ellis). 1862, Dresden. Fork given by the Direction of the Court Theatre to its librarian, Herr Moritz Fürstenau, to represent the pitch after the Conference and Experiments of Pitch held at the theatre (see above Art 28), and kindly sent to me for measurement. Meant for A 440. (See A 438·9 and A 439·1.) This is a good specimen of varieties of forks meant to have the same pitch.

(1) A **438·0**, EC 520·9 [MC 524, JC 525·6], S 2·92. (Cagniard de la Tour from de la Fage.) 1829, Paris; Opéra Comique.

*(2) A **438·0**. (Stone.) 1877, Westminster-abbey. Observed by Dr. W. H. Stone with a König's V 435, in the Abbey, in May; temperature unknown. (See (2) A 422·5.)

EA **438·2** [MA 441·7, JA the same, if we assume it to be a major Third below the C *sharp* measured], EC 521·2 [MC 528·4, JC 530, if we take it a just minor Third above the JA just determined], 2 C *sharp* 276·07, S 2·93. (De Prony, "Méc. Anal.," Part II, p. 495.) 1815, Paris. An iron wire, 0·5825 metres long, weighing 0·615 grammes, and stretched by a weight of 11134 grammes, was in unison with C *sharp*, but of what pitch is not said. Perhaps this C *sharp* and the F of EA 414·5, which see, were only those on De Prony's own pianoforte. The pitch given agrees with that calculated by the common formula (see Art. 13, note 6).

MA **438·5** [JA 437·1, EA 441·1], C 524·5, S 2·94. (Cavaillé-Coll.) 1800*c*, England. Fork of English make, formerly belonging to M. Aristide Cavaillé-Coll's father, communicated by M. Cavaillé-Coll.

(1) MA **438·9** [EA 436·3], MC 525·2 [EC 518·8], 2 F *sharp* 366·9, S 295. (Ellis.) England; Boston Organ, Lincolnshire. Attributed to Christian Smith, 1696. The pipe was a flute stop, and very uncertain. There was, also, a 2 A, much cut, giving A 458·4, which could not fit into the above, and is extremely sharp, belonging to the A 454·2 series; so that there is, probably, some mistake. As measured from F *sharp*, the organ approaches to the pitch of B. Schmidt, of whom Chr. Smith was a nephew. Both pipes belong to Messrs. Hill and Son, who repaired the organ.

(2) A **438·9**, EC 522·0 [MC 525·1, JC 527·3], S 2·95. (Ellis.) 1869, Dresden Theatre. Fork sent officially from Leipzig to the Society of Arts, and lent for measurement. (See also A 437·8, 439·1, and 440·4.)

*MA **439·0** [JA 437·5, EA 441·5], C 525, S 2·95. (Ellis.) London; St. Mary's Chapel, Paddington, next the Lying-in Hospital, date and maker unknown. The organ was repaired by Messrs. Bevington, and the 2 C 262·5 was measured direct; also another C 526·3, a fifteenth of the mounted cornet, great organ; a stop which has long gone out. I have taken the pitch from the larger pipe.

(1) MA **439·4** MC and JC 525·6 [EC 521·5], 4 E 164·25, S 2·97. (Delezenne.) No date, Lille. Old fork, purchased at the sale of the Marquis d'Aligre; prongs, 174 mm. long. From its value, 4 E 164·25, Delezenne first derived 4 JC 131·4; and then, taking three just Fifths up, reached 2 A 443·48, which he regarded as the pitch. But this would only do on the open strings of a tenor violin. The organs used the flatter Fifths of the meantone temperament. Hence I have derived the MA, MC, JC, and EC immediately from the pitch of E.

(2) A **439·4**, EC 522·5 [MC 525·6, JC 527·2], S 2·98. (Scheibler's "Tonmesser," p. 53. No. III.; given as A 439·15 at 69° Fahr., here corrected to 59° Fahr.) 1834*c*, Vienna; Opera. Fork belonging to Scheibler or his friends.

(3) A **439·4**. EC 522·6 [MC 525·6, JC 527·3], S 2·97. (Ellis.) 1878, Dresden Opera. Fork prepared for me by the Court organ-builder Jehmlich, and sent to me by Herr Moritz Fürstenau, librarian of the theatre. (See also A 438·9, 437·8.)

(1) A **439·5**, MC 525·7 [JC 527·3, EC 522·6], S 2·98. (McLeod and Ellis.) 1812, France; Paris Conservatoire. Copy of a fork (compared with the original, which is not in good condition, by M. Cavaillé-Coll, who pronounced it "sufficiently correct") preserved in the Musée du Conservatoire (No. 492 of catalogue), and purporting to be that used in 1812 at the Conservatoire. (Compare A 440·9, and A 435·2.) The catalogue says that it is the fifth of a tone flatter than the diapason normal; it is, actually, S 0·16 sharper. Length of the original, from bend to prong, $3\frac{3}{4}$ in. converging prongs, conical brass cup at bottom of stem. The top is crushed, as if from being held in a vice. The fork is a very poor one, and its sound is scarcely audible for 10 sec.; but, as compared by my son, it also gave A 439·5.

*(2) EA **439·5** [MA 436·9, JA 436·5], C 522·7, S 2·98. (Ellis.) 1855; Organ of Parish Church, Barking, Essex. The original organ was built by Byfield and Green, 1770; but the pipes were shifted a Tone, and cut and equally tempered, by Walker in 1855. It was, therefore, probably an A foot organ originally, for A 474·1 gives B *flat* 507·3, which is just a quarter of a Tone flatter than C 522·7, and hence could be easily cut down to it, and the markings on the pipes show that old B *flat* was made into new C.

A **439·9**, EC 523·2 [MC 526·3, JC 527·9], S 2·99. (Delezenne.) Turin, 1845. Fork obtained and lent to M. Delezenne by M. Marloye.

(1) A **440·0**, EC 523·25 [MC 526·36, JC 528], S 3·00 (Lissajous, cited by de la Fage.) Paris, 1829. Orchestra pitch of opera (see A 425·8). Fork verified by M. Monneron for A. de la Fage.

(2) A **440·0**. (Wieprecht, cited by Fr. Com.) 1830, Berlin; opera. Original statement by Wieprecht not found.

*(3) EA **440·0** [MA 437·4, JA 436], C 523·2, S 3·00. (Ellis.) 1878, London. Messrs. Gray and Davison's standard pipe for organs. They told me they had lowered their pitch lately.

(1) A **440·2**, EC 523·5 [A1 C 526·6, JC 528·3], S 3·01. (Scheibler measured this as A 440 by his own forks, which were adapted for 69° Fahr.; hence, correcting to 59° Fahr., we have the above.) 1834, Stuttgart; Congress of Physicists, who accepted Scheibler's proposal, which Scheibler says ("Tonmesser," p. 53), was selected as the mean of the variation of Vienna grand pianos by temperature. de la Fage says that this very fork was measured by Lissajous in 1856, at the request of M. Bodin, and found to be A 440·3. The French measures are intended for 59° F., = 15° C. Hence the difference would be only V 0·1; and, if Lissajous really measured at 55° Fahr., the agreement would be complete. But, as the great Diapason Normal is A 435·4, in place of A 435, there is no reason to suppose that the measure was made with such extreme accuracy. Whether this standard fork exists still, and where, or how it is preserved, I do not know.

*(2) EA **440·2** [MA 437·7, JA 436·3], C 523·6, S 3·01, pressure, 3 in. (Ellis.) 1879, London; Messrs. Walkers' standard pipe.

A **440·3**, EC 523·6 [MC 526·7, JC 528·4], S 3·01. (Scheibler's "Tonmesser," p. 53. No. IV. given as A 440·1 at 69° Fahr, and here corrected to 59° Fahr.) 1834*c*, Vienna Opera. Fork belonging to Scheibler or his friends.

MA **440·4** [JA 439·0, EA 492·9], C 526·8, 2 C 263·4, S 3·01. (Ellis.) London, date unknown. Old fork, found by Messrs. Bishop in an old amateur organ at Westminster. It was a large fork, giving the 2 C.

(1) A **440·5**, EC 523·8 [M C 526·9, JC 528·6], S 3·02. (Delezenne.) 1840, Paris Opera. Fork said to have been adjusted to this pitch by M. Pleyel, date unknown.

*(2) A **440·5**. (Delezenne.) 1854, Lille. Organ of St. Catherine, repaired, and evidently re-tuned to concert pitch.

*(3) EA **440·5** [MA 437·9, JA 436·5] C 523·7, S 3·02. (Ellis.) 1878; Messrs. Bevington's standard pipe. But Messrs. Bevington said that they have since raised their pitch 2 to 4 beats; hence, possibly, they use about E A 444, C 528.

A **440·9**, EC 524·3 [MC 527·5, JC 529·1], S 3·03. (Scheibler's "Tonmesser," p. 53, No. 4, where it is given as A 440·7, at 69° Fahr., and is here reduced to 59° Fahr.). 1834*c*. Paris. Conservatoire Concerts and Italian Opera (cited by M. Cavaillé-Coll as Scheibler's pitch of Grand Opera in 1834). This was not trusted by Scheibler's so much as A 435·2.

(1) A **441·0**, EC 524·5 [MC 527·6, JC 529·2], S 3·04. (Delezenne.) 1836-39, Paris Opera. Fork of M. Leibner, whose duty it was to keep the pianos of the opera to the pitch of the orchestra, for rehearsals. Verified by Meyerbeer at the rehearsal of the "Huguenots." In 1849 it agreed precisely with the oboe of M. Verroust, which gave the pitch at performance.

(2) A **441·0**. (Cagniard de la Tour, from de la Fage and Cavaillé-Coll). Paris, 1836; Opéra Comique.

(3) A **441·0**. (Fr. Com.), 1859, Dresden Opera. Fork apparently sent by Kapellmeister Reissiger, who wrote, "The great elevation of the diapason destroys and effaces the effect and character of ancient music—of the master-pieces of Mozart, Gluck, and Beethoven." Reissiger's own fork was (1) A 435. The Dresden pitch was intentionally A 440. (See A 438·9, see, also, the proceedings of the Dresden Conference, Art. 28, above.)

(4) EA **441·0** [M A 438·3, J A 437], C 524·4, S 3·04. (Ellis.) 1879, London. Church organ pitch of Messrs. Lewis, of Brixton, from a fork lent me by these well-known organ-builders.

A **441·1**, EC 524·5 [MC 527·7, JC 529·3], S 3·04. (Scheibler's "Tonmesser," p. 53. No. V., where it is given as A 440·87 at 69° Fahr., and here reduced to 59° Fahr.) 1834. Vienna opera. Fork given by Pro. Blahetka to Scheibler as a trustworthy A of the Vienna orchestra. Cited as A 440·7 by Delezenne, who confused it with the Berlin fork, A 441·8; de la Fage apparently cites this as both A 440·37 and A 440·33. This fork was found in a lumber

room in Scheibler's former dwelling in 1879, and was lent to me for examination. It had the words, "Professor Blahetka, Wiener Orchestra," written on the inside of the prongs. It had, apparently, been slightly wrenched, and could not well be counted for 6 secs.; it was also exceedingly rusty. Its present pitch, so far as I could ascertain, is A 439·9, so that it has lost V 1·2, owing to ill-treatment. This is the largest loss in any tuning fork I have yet been able to ascertain (see Art. 10 above, and A 441·8, (1) A 443·2 below).

A **441·2**, EC 524·7 [MC 527·8, JC 529·4], S 3·05. (Ellis.) 1878, London, Covent-garden. Fork then in possession of Messrs. Bryceson (since retuned), giving the pitch to which the organ at Covent-garden Opera was tuned in 1878. In 1879 it was raised to A 445·6, which see, while in the theatre itself Mr. Hipkins observed it by beats with his own fork as A 449·7, which see. Mr. Hipkins also recorded the pitch of the harmonium at Covent-garden, June, 1877, as A 449·2, and in July, 1878, as A 447·5, while the orchestra at this last date was A 449·9. See these numbers. The heat of the theatre sharpens the organ, so that when, in 1879, Mr. Pitman, the organist, adopted the plan of keeping the A of the organ going for half an hour for the band to tune by, the pitch rose. In 1880, the pitch is to be reduced to the French A 435·4.

EA **441·3** [MA 438·8, JA 437·8], C 524·8, S 3·05. (Ellis.) 1842, London. Fork bought about 1842, when Mr. Hullah was giving lessons in singing on Wilhem's method, and issued by his authority, stamped, "Do. 512, vib. per sec. C. J. W. Parker, West Strand." Another copy issued at the same time, and bought by Mr. de Pontigny, measured C 525·06, or within 0·2 vib. of the same pitch. The error was therefore not the fork maker's. In his report to the Society of Arts on Uniform Musical Pitch, 3rd June, 1859, Mr. Hullah says that the original of this fork was tuned by the siren, and that it had been largely used, and that several important organs had been tuned to it, and also states in a note that Mr. J. H. Griesbach had measured the fork by his process, and found it C 521·6. This statement shows the untrustworthiness of both methods. A particular point had been made of reaching C 512, and C 524·8 resulted, being S ·43 too sharp, that is very nearly a quarter of a tone, and not, as Mr. Hullah says, a quarter of a semitone.

* (1) MA **441·7** [JA 441·0, EA 446·1], MC 528·4 [JC 531·7, EC 530·5], B *flat*, 472·6, S 3·07. (Ellis.) 1690, Hampton-court. Bernhardt Schmidt's Organ. Firstly, a B *flat* pipe (12 in. long and 1·2 in. in diameter), belonging to this organ before it was altered by Messrs. Hill and Sons, and in possession of Messrs. Broadwood, was measured as 470·9, at first; but after the mouth had been cleaned at 472·9 and 472·3, mean 472·6, here adopted, all reduced to 59°F. Messrs. Hill informed me that they had not altered the pitch of C when repairing the organ. Secondly, on 15th August, 1878, I measured the pitch of C of the Choir Organ at Hampton-court Palace as C 528·7. (See MA 442.) Thirdly, on 14th October, 1878, I measured at Messrs. Hill and Sons' a perfectly untouched 1 A from the old Echo Organ at Hampton-court. I had to tune a pipe to the Octave below, as my measuring forks did not reach so high, and this gave me A 441·25 at 59° Fahr., whence MC 527·9. Fourthly, Dr. Robert Smith ("Harmonics" 1859, p. 192) measured this Trinity College Organ D, which was B. Schmidt's original C (for the pipes had been shifted), in September, "at temperate or thereabouts," as V 524; in November, when "cold," as V 508; and in August, when "pretty hot," as V 536. If we assume "pretty hot" to mean 72° Fahr., "temperate or thereabouts" to be 50½°, and "cold" to be 21° Fahr., which is possible, then the numbers of these three temperatures gives the original C as 528·8, 528·6, and 528·1 respectively, which agrees remarkably well with the above MC 528·4. Dr. R. Smith's method of measuring by a weighted string was perhaps not safe within 4 or 5 vib., and the method of reduction of temperature is also not perfectly safe. From these measurements, there can be little doubt that this was one of Bernhardt Schmidt's pitches. (Mr. T. Hill is positive that there is no trace of the pipes ever having been shifted.) But it also seems to be certain that he used a sharper pitch at St. James's Chapel Royal, and Durham Cathedral. (See A 474·1.) What he used at St. Paul's cannot be inferred with certainty. (See A 444·7.) The Temple organ is also doubtful. All these organs seem certainly to have this pitch at one time, and both the Temple and St. Paul's were flattened by Bishop. (See end of remarks on (1) A 422·5.)

* (2) MA **441·7**, (Hill.) 1814*p*, London; Whitehall, Banqueting-room. Mr. T. Hill says that this organ was sharp, and of the same pitch as Hampton-court before he altered it; but it had been altered by Elliott in 1814. It is possible, however, that it was originally as sharp as the original Durham organ (see A 474·1), before Mr. Hill had to deal with it. It was the first organ built by Bernhardt Schmidt in England. Indeed, it is said that Charles II. sent for him on purpose to build it. It was always in the banqueting-room; so that it escaped the flames when the chapel was burned, and George I. afterwards opened the banquetting-room as the Chapel Royal. Purcell was organist there.

(3) A **441·7**, EC 525·3 [MC 528·4, JC 530·0], S 3·07. (De Prony, from de la Fage.) Paris, 1832. Proposed as a standard by De Prony, according to A. de la Fage. It will be observed that the EC and JC here are different from what they are in (1) MA 441·7. The reason is that here they are taken from an original A, and there from an original B *flat*.

* (4) EA **441·7** [MA 439·1, JA 437·8], C 525·3, S 3·07, pressure 2¾ inches. (Ellis.) London, Aug. 1878. Standard pipe of Messrs. Hill and Sons, organ-builders. Here again the numbers are different from (1) MA 441·7, because they are calculated from an original C.

A **441·8**, EC 525·4 [MC 528·6, JC 530·2], S 3·07. (Scheibler, "Tonmesser," p. 53, given as A 441·625, here reduced to 5·9° Fahr.) 1834 *c*, Berlin; Opera. Considered by Scheibler a trustworthy fork of the Berlin Orchestra; but he was certain that Berlin forks varied V 1·5 to V 2, and thought this sufficient to make a part possible or impossible to a singer. M. Cavaillé-Coll, who cites this, also cites A 441·025 as a pitch of the Vienna opera measured by Scheibler, but I do not find it in his book. This fork was found at the same time and place as A 441·1; it has been a good fork, and can easily be counted for 10 seconds, but it is very rusty. It now measures A 440·9. Hence it has lost V 0·9. The other fork had lost V 1·2. The beats between the forks in Scheibler's time were 0·76 per second. They were now, by the measurements, 1·07, and by observation 1·0, which was difficult to observe with accuracy on account of the badness of the other fork. Hence the beats between them have increased ·24 to ·3. This is accounted for by the difference of their loss, 1·2 − ·9 = ·3. This loss by rust is considerable. Large forks do not seem to suffer so much. Scheibler's V 219, found at the same time, is now V 218·77, and hence has lost ·23 by rust. (See A 443·2 below, and Art. 10 above.)

* (1) MA **442·0** [JA 440·6, EA 444·6], C 528·7, S 3·08. (Ellis.) London, 1690. B. Schmidt's Organ, at Hampton-court, measured from the unaltered C of the choir organ (see MA 441·7). Messrs. Hill had altered the temperament to equal, and I measured their EA 445, which agrees closely with the above. All reduced to 59° Fahr.

(1) A **442·5**, EC 526·2 [MC 529·3, JC 532·0], S 3·10. (Delezenne.) 1854, Paris; Italian Opera. As determined by reeds giving that pitch, for which there is no other authority.

(2) A **442·5**. (Fr. Com.) 1859, France; Toulouse, Opera. (See (2) A 437·0.) Fork sent by M. Mériel, Director of the School of Music at Toulouse.

(3) A **442·5**. 1859; Brussells, Theatre. Pitch recommended and used by M. Bender, Musical Director to the King of the Belgians, a quarter of a tone flatter than his military pitch, A 455·5, which see.

* A **442·7**, EC 526·5 [MC 529·6, JC 531·2], S 3·11. (Ellis.) 1878, Austria. Small Franciscan organ at Vienna, kept at modern pitch (compare St. Stefan, A 443·2) for the purpose of musical services and performances ("zur Benützung bey musikalischen Aemtern oder Aufführungen"). From a fork tuned for me by Organ-builder Ullmann, who also tuned C 525·5, showing that the temperament was equal, but not quite perfect. (See large organ, A 457·6.)

(1) **443·0**, EC 526·8 [MC 529·9, JC 531·6], S 3·12. (Fr. Com.) 1859; Bordeaux, Opera. Apparently the fork sent by M. Mézerai, conductor of the orchestra, who said that he first adopted the Paris pitch, A 448, but found it fatigued his singers too much. Yet the difference between that pitch and this is barely a comma.

(2) A **443·0**. (Fr. Com.) 1859, Germany, Stuttgardt, Opera.

* (1) A **443·1**, MC 530·1 [JC 531·7, EC 526·9], S 3·12; pressure 3 in. (Ellis.) 1815*c*, Durham; organ built by Bernhardt Schmidt, as altered by shifting. One of the original pipes, 2 B *flat*, was of exactly the same dimensions as that from Hampton-court (see A 441·7); but, as it had been pieced by Bishop, I selected the 2 A, which was unpieced. It is, however, certain that this 2 A was originally Schmidt's 2 G *sharp*, giving A 474·1, which see. The present organ, by Willis, is in his own pitch (see A 444·7).

(2) A **443·1**, EC 527·0 [MC 530·1, JC 531·8], S 3·12. (Ellis.) 1869, Italy; Bologna, Liceo Musicale. Fork sent officially to the Society of Arts as representing the pitch used at this Liceo. Measured graphically by Sig. Lorenzo della Casa, Professor of Physics at Bologna, and the engineer Sacchetti, and by the siren by Sig. Carlo Verardi, Professor of Music there, as 443·88; apparently a mean of many attempts. Meant for A 444.

(1) A **443·2**, EC 527·1 [MC 530·3, JC 531·9], S 3·13. (Scheibler, as cited by Delezenne, who gives A 443·0; but, if Scheibler published the numbers, they must be reduced to 59° Fahr., as above.) 1834, Vienna; Streicher. Although I cannot find this pitch in Scheibler's "Tonmesser," a fork, with diverging prongs, and very rusty, was found at the same time as the forks A 441·1 and 441·8, bearing the name "Streicher," in ink, inside one prong. The fork now measures A 442·78; hence it has, apparently, lost V 0·43 by rust, which is not excessive. (See Art. 10, above.)

* (2) A **443·2**, EC 527·1 [MC 530·2, JC 531·7], S 3·13. (Ellis.) 1878, Austria; Vienna, St. Stefan Cathedral Organ. From a fork especially tuned for me by the Organ-builder Ullmann, giving A 440·1 at 9° R. The pitch was intended to be the same as the opera (see A 446·8), and the organ was tuned to the same fork. If so, there must have been an insufficient allowance for temperature. This is, however, a modern pitch, and does not at all represent the ancient pitch of this organ, which was a very old one when described by Hopkins ("Organ" ed. 1870, p. 406).

(1) A **443·3**, EC 527·1 [MC 530·3, JC 531·9], S 3·13. (Wölfel.) 1836, Paris; Wölfel's pianos. Cavaillé-Coll, who cites this pitch, explains that Wölfel, a pianoforte-maker in Paris, made a tonometer for himself from Scheibler's description. Delezenne and de la Fage attributes the measurement to Scheibler, but I find nothing about it in Scheibler's works.

(2) A **443·3**. (Fr. Com.) 1859, Germany, Gotha, Opera.

* EA 443·4 [MA 440·8, JA 439·4], C 527·3, S 3·13. (Ellis.) 1878, London; Messrs. Bryceson's standard pipe.

A 443·5. EC 527·4 [MC 530·5, JC 532·2], S 3·14. (Fr. Com.) 1859, Germany, Brunswick, Opera. Fork apparently sent by Kapellmeister Franz Abt.

* (1) EA 443·7 [MA 441·0, JA 439·6], C 527·6, S 3·14; pressure, 3 in. (Ellis.) England; Salisbury, St. Edmund's; the pitch subsequently raised. From a pipe at Messrs. Walkers. Date unknown; pitch apparently modern.

* (2) EA 443·7. (Ellis.) London, St. George's-in-the-East. From a pipe in possession of Messrs. Walkers.

EA 444·0 [MA 441·4, JA 440], C 528, S 3·16. 1860. Intended, but unexecuted standard of the Society of Arts. For real standards, see A 449·4 and 445·7; and for copies, see A 448·0, 448·4, 445·1. This was also proposed by M. Aristide Cavaillé-Coll in 1858 (see A 444·3).

EA 444·2 [JA 440·2, MA 441·5], C 528·2, S 3·16. (Ellis.) London. Old fork, date unknown, marked "C., Philharmonic." I cannot assign a date, but, as it does not belong to the old C 528 pitch, I put it in eq. temp.

* A 444·3, EC 528·4 [MC 531·5, JC 533·1], S 3·17. (Cavaillé-Coll, "du Ton Normal," p. 13.) 1840. France; St. Denis, cathedral organ, as re-built by M. Cavaillé-Coll, who advocates the use of A 444, EC 528 for the standard, like the Society of Arts.

(1) EA 444·5 [MA 441·0, JA the same], EC 528·5 [MC 527·5, JC 529·2], 16 F 44·098, S 3·18 (De Prony, "Mée. Anal.," Part 2, p. 495.) 1815, Paris. It was determined as the unison of a brass wire, 1·48 mètres long, weighing 12·783 millegrammes, and stretched by a weight of 15,000 millegrammes. The usual formula (Art. 13, note 5) gives the same result. Of course, there is considerable uncertainty. Possibly both this experiment and the former (A 438·2) referred to the same real pitch, but, if so, as they differ by V 6·3, they would serve to show the untrustworthiness of the method. De Prony uses equal temperament only, and considers that this pitch is that of the actual orchestra, which he says is about one-twelfth of an octave above the old ton d'église employed by Sauveur. He reduces this and the experiment in EA 438·2 to give C 132·29 and C 130·36 (which should be, taking equal temperament, EC 132·14 and EC 130·28). Then he reduces both by one semitone, and obtains what he supposes to be the old ecclesiastical pitches, C 124 and C 123 (which should have been C 124·7 and C 122·97); and he then compares them with Sauveur's C 122 (which should have been C 120·875, see A 406·6). The whole process is entirely erroneous. Equal temperament should not have been employed, nor can the orchestral pitch of 1815 be assumed as the ton de chambre of the ton d'église of 1713; nor, finally, does Sauveur represent his pitch as the ton d'église. The mean of these two experiments of de Prony, is EA 441·35. M. Cavaillé-Coll ("Du Ton Normal," p. 13) cites from de Prony the mean of two experiments in 1832 (instead of 1815) as A 441·915. Can they be corrections of the same?

(2) 444·5. EC 528·6 [MC 531·74, JC 533·3], S 3·18. (Lissajous, from de la Fage). 1858, Madrid, Theatre Royal. Sent to Adrien de la Fage by D. Hilarion Eslava, Maitre de Chapelle to the Queen of Spain. The ton de chapelle is said to be an equal semitone flatter. (See A 419·6.) [French pitch was adopted by the Spanish Government, 18th March, 1879.]

* EA 444·6 [MA 442, JA 440·6], C 528·7, S 3·18. (Ellis.) 1877, London; St. Paul's Organ. Fork, in possession of Mr. Hipkins, tuned to a piano which had been tuned to St. Paul's organ for the performance of the Passion Music in March, 1877, and had been observed by the organist, Dr. Stainer, to go well with it. But this was after the organ had been adjusted and almost rebuilt by Willis to his own pitch, A 445·2, which is only V·6 sharper than the above, and hence implies that the piano was tuned to the organ at 57·5° Fahr. in place of 59° Fahr.

* A 444·7, EC 528·9 [MC 532·0, 533·6], S 3·18. (Ellis.) 1879, England. Durham Cathedral organ, after it had been rebuilt by Willis to his own pitch, A 445·2, from which my measurement differs by only V 0·5, and considering that the Durham organ was measured in the organ at 44° Fahr., and Mr. Willis's standard pipe separately at 61·5° Fahr., and then both reduced to 59° Fahr., it shows a very satisfactory agreement.

(1) A 444·8 EC 528·9 [MC 532·0, JC 533·7], S 3·19 (Fr. Com.) 1859, Italy, Turin, Opera. This was apparently the fork sent to the Commission by M. Coccia, director of the Philharmonic Society at Turin, and *maestro di capella* of the Cathedral of Novara. M. Coccia says that this pitch is the mildest (*il piu mite*) that he has met with.

(2) A 444·8 (Fr. Com.) 1859, Germany, Weimar, Opera.

(3) A 444·8 (Fr. Com.) 1859, Würtemberg; concerts. Fork apparently sent by Herr Joseph Abenheim, Kapellmeister.

(1) A 444·9, EC 529·1 [MC 532·21, JC 533·8], S 3·19. (Lissajous, from de la Fage.) Naples, 1857; San Carlo. Fork sent by Mons. E. Guillaume, conductor of the band of the Theatres Royal, Naples, to the (French) Society of Pianoforte-makers.

(2) A 444·9. (Hipkins.) 1880, London; her Majesty's Opera. Fork of the theatre. See (2) A 436·1, and (2) A 445·5.

(1) A 445·0, EC 529·2 [MC 532·3, JC 534], S 3·20. (Näke.) 1862. Austria, Vienna, Pianos. The piano of Kapellmeister Proch, while the opera was at A 466, which see; and also A 454·.

(2) A 445·0. (Schmahl.) Germany, Hamburg. This is given me by Herr Schmahl (see A 494·5) as the "old Hamburg pitch," but at what date is not stated.

(1) A 445·1, EC 529·3 [MC 532·4, JC 534·1], S 3·21 (Scheibler's "Tonmesser," p. 53, No. VI., given as 444·87, at 69° Fahr., and here reduced to 59° Fahr.). 1834*c*, Vienna, Opera. Fork belonging to Scheibler or his friends, the highest of six of Vienna, of which he gives the measure, and he considers it to be a "monstrous growth" (*Auswuchs*). This is, apparently, the fork cited as A 445 by Delezenne (Lille Mem., 1854, p. 15), and also by Cavaillé-Coll ("Du Ton Normal," p. 13). It is cited both as A 445 and A 445·44, apparently by de la Fage, who gives the latter number to the Vienna Conservatoire.

(2) EA 445·1 [MA 442·5, JA 441·1], C 529·3, S 3·20. (Ellis.) London, 1878. Fork sold by Cramer as Society of Arts pitch, in possession of Messrs. Bishop, organ-builders.

*EA 445·2 [MA 442·5, JA 441·2], C 529·4, S 3·20. (Ellis, at 59° Fahr.), London. Church pitch of Mr. Henry Willis, to which are tuned the present organs of St. Paul's and Durham Cathedrals (see A 444·6 and A 444·7), and also of Salisbury Cathedral, built 1878, of Glasgow Cathedral (Established Church of Scotland), and the new Episcopal Cathedral of St. Mary, Edinburgh, all recently built by Mr. Willis. This pitch was derived from a pipe tuned at 65° Fahr. to a Society of Arts fork, by an unknown maker, now mislaid. Now, the pipe giving C 529·4, at 59° Fahr., will sound C 532·7, at 65° Fahr., whence we derive EA 447·9. This makes it probable that it was one of Cramer's forks (see A 448·4). It was really flatter than Griesbach's C 534·46, intended for C 528 (see A 449·4). I am much indebted to Mr. Willis for much polite attention respecting his organs.

A 445·4, EC 529·7 [MC 532·9, JC 534·5], S 3·21 (Delezenne.) Vienna, 1845; Conservatorium. Fork obtained, and lent to M. Delezenne by M. Marloye.

(1) EA 445·5 [MA 442·8, JA 441·5], C 529·7, S 3·21. (Ellis.) London, 1860. Copy of Broadwood's medium pitch, made for the Society of Arts, 1860 (see EA 445·9 and 446·2).

(2) A 445·5. (Hipkins and Ellis.) October, 1879, London. Her Majesty's Opera band during performance, from a fork tuned by Mr. Hipkins, and measured by me (see (2) A 444·9).

A 445·6, EC 529·9 [MC 533·1, JC 534·7], S 3·22. (Ellis.) 1879, London, Covent-garden. Fork in the possession of Mr. Pitman, organist, and Sig. Vianesi, conductor, to which the organ at Covent-garden Opera was tuned at the beginning of the season of 1879. Mr. Pitman said that the new pitch was settled at the end of the previous season, because it was impossible to get the oboe, bassoon, and flute to play at a lower pitch. He also said that the singers themselves, having been used to a higher pitch, objected to using a low one. During actual performance, when the organ A was given out for the band to tune from, Mr. Hipkins found A 449·7; see also A 441·2.

A 445·7, EC 530·1 [MC 533·2, JC 534·8], S 3·22. (Ellis.) 1860, London. Fork made by Mr. J. H. Griesbach to represent 2 A equally tempered to his 1 C 528, which was really C 534·46 (see A 449·4). The box containing it says:—"The Pitch of the Fork producing the note 2 A [in musical notation] derived from the above-named 1 C [also in musical notation], was obtained by a monochord, the length of its string 20 in., tuned to the note 2 C [in musical notation] from the 1 C 528 vibrations in a second, the whole length of string being equal to 1,000, the tempered 2 A is produced by ·594 thousands." It should be ·5946036. With so short a string, tuned to the Octave below by ear only, errors were inevitable. It is remarkable that this pitch is more nearly what was wanted (A 444) than Griesbach's C 534·46 (see A 449·4). Fork lent by the Society of Arts. (See (2) A 448·4.)

*(1) MA 445·8 [JA 447·2, EA 450·2], MC 533·3 [JC 536·6, EC 535·4], 2 B *flat* 477; pressure, 2⅝ in.; S 3·23. (Ellis.) Experimental pipe, intended to be an exact copy of the Hampton-court B *flat* pipe (see A 441·7). The length, diameter, and pressure of wind were the same; yet, instead of 472·6, I obtained 477. The difference must have been in the mouth, foot, and newness, and serves to show the kind and amount of error (S 0·15) that may be expected in the numerous cases where I have had new pipes constructed. Under 3¼ in. and 4 in. pressure, the pipe gave B *flat* 478·1 and 480·01, whence MA 446·8 and 448·6. But the pressure, 2⅝ in., has been retained here because it was that used at Hampton-court, where the original pipe existed.

(2) A 445·8, EC 530·15 [MC 533·33, JC 535], S 3·23. (Lissajous, from de la Fage.) 1856, Paris, Opera. Exact pitch, on the authority of M. Bodin, professor of the piano and harmony.

(3) EA 445·8 [MA 443·1, JA 441·8], C 530·1, S 3·23; pressure, 3 in. (Ellis.) 30th September, 1867, London, Exeter-hall. Both organs, built by Messrs. Walker; measured from a pipe of the larger organ in their possession. It has since been sharpened to A 447·3.

EA 445·9 [MA 443·3, JA 441·9], C 530·3, S 3·23. (Ellis.) London, 1849-51. Broadwood's original medium pitch, belonging to the widow of the tuner Alex. Finlayson, who died 1854. The original fork having gone out of the possession of Messrs. Broadwood, a copy was substituted for it, C 530·6. An older copy, made for the Society of Arts in 1860, is C 529·7. These different values, 529·7, 530·3, 530·6, are good examples of the errors usually made in copying. (See EA 445·5 and 446·2.) This pitch was chosen quite empirically, by filing down an older fork. The present fork is the one of which a copy was sent to the French Commission on Pitch, 1859, and is called in their Report No. 2, A 452·5, showing that some grave mistake must have been made in measuring, calculating, or printing.

(1) A 446·0, EC 530·4 [MC 533·5, JC 535·2] S 3·23. (Delezenne.) 1854*a*, Paris; Pleyel's pianos. Fork given to Delezenne by M. Saunier, organist and music-seller, Lille.

(2) A 446·0. (Näke.) 1859, Dresden, Opera. No authority but Näke's own is given, and in Dresden, it is denied that the pitch was ever so high. (See, 438·9.) But, during the performance, the pitch may have risen with the temperature, as it would affect the wind instruments. This was probably the case here, the pitch being taken during performance. (See A 445·6, 447·5, 449·9.)

(3) A 446·0. (Fr. Com.) 1859. Austro-Hungary, Pesth, Opera. Apparently from a fork sent by the Kapellmeister, Herr Franz Erkel, who considered it high time to stop the irregularities which had been hitherto allowed in pitch.

* (4) MA 446·0, MC 533·6, *B natural* 493·63; pressure, 3¼ inches; S 3·23. (Ellis.) This was merely an experimental pipe, to show the effect of a difference of diameter, when the length remains unaltered. This pipe was 12 inches long and ¾ inch wide; compare A 445·8, for one, 12 inches long and 1·2 inch in diameter; A 434·7, for one, 12 inches long and ·75 inch diameter. The following is a comparison of results:—

Pressure.

Diameter.	2½ inch.	3½ inch.	4 inch.
1·2 in.	V 477·04	478·1	480·01
[·95 in.	V 486·87	488·71	490·49
·75 in.	V 497·21	498·63	500·15

(1) EA 446·2 [MA 443·6, JA 442·2], C 530·6, S 3·24. (Ellis.) London, 1·54-79. The copy of Broadwood's medium pitch, now used in their house for pianos not meant for public concerts. See EA 445·9. This is the pitch to which Mr. Randegger has adapted his indications of compass of voice. See Art. 21 above.

(2) A 446·2, EC 530·63 [MC 533·77, JC 535·2], S 3·24. (Lissajous, from de la Fage.) 1856, Paris, Opera. Fork communicated to the French Society of Pianoforte-makers, 1st September, 1856.

(3) A 446·2 (Lissajous, from de la Fage.) 1856, Paris Conservatoire.

(4) A 446·2, EC 530·6 [MC 533·7, JC 535·4], S 3·24. (Fr. Com.) 1859, Holland; the Hague Conservatoire. Apparently the fork sent by M. Lubeck, director of the Conservatoire there, who said that he himself had had to contend with continual rise of pitch.

A 446·6, EC 531·1 [MC 534·2, JC 536], S 3·26. (Delezenne.) Milan, 1845. Fork obtained and lent to M. Delezenne by M. Marloye.

A 446·7, EC 531·2 [MC 534·4, JC 536] S 3·26. (Ellis.) 1876, London. Fork bought at Messrs. Cramers', as giving concert pitch; I was offered the Society of Arts forks if I liked, "they only differed by a shade." The corresponding C fork bought at the time was C 533·24, and hence not quite in correct tune with it. I don't know where they were using such a pitch at the time. But I had bought a fork elsewhere, marked "A Walker," some years before, which gave A 446·4, practically the same.

(1) A 446·8, EC 532·5 [MC 535·7, JC 536] S 3·27. (Delezenne.) Lille, 1851. Festival organ. Fork by which M. Mazingue tuned the organ.

(2) A 446·8. EC 531·3 [MC 534·5, JC 536·27] S 3·27. (Ellis.) 1878, Austria, Vienna. Pitch of the opera from a fork sent to me by the organ-builder, Ullman, who had charge of the organ there, as the pitch to which it was tuned. This would, of course, rise with the temperature of the house. In 1860, French pitch was introduced and, was still the rule in 1869, as officially communicated to the Society of Arts. See A 435·4. The modern rise, which is stated to be several years old, is comparable to that of Covent Garden Theatre. See A 441·2, 445·6, 449·9. For the pitch of the Vienna opera, before 1853, see A 456·1. To the above pitch were tuned the organs of St. Stefan (see A 443·2), St. Michael, St. Peter, and St. Maria Schnee (formerly Minoriten Kirche), This must, however, be taken only as the mean pitch. The church organ of St. Michael was once as high as the larger Franciscan organ (see A 457·58), but the pipes have been pieced throughout, and the pitch lowered. (Abstracted from notes by Herr Ullmann).

A 447·0, EC 531·8 [MC 534·7, JC 536·4], S 3·27. (Fr. Com.) 1859, France, Marseilles, Conservatoire. M. Aug. Morel, director of the School there, a branch of the Paris Conservatoire, wished to retain old French pitch in order to preserve the brilliancy of the orchestra.

A 447·3, EC 531·9 [MC 535·0, JC 536·7], S 3·28; pressure, 3 in. (Ellis.) 1879, London, Exeter-hall. Both organs built by Messrs. Walker; from a pipe in their possession (see their former state B 415·8.)

A 447·4, EC 532·06 [MC 535·2, JC 536·9] S 3·29. (Lissajous, cited by de la Fage.) Paris, 1856; Italian Opera. Fork communicated by M. Bodin, professor of the piano and harmony.

A 447·5, EC 532·2 [MC 535·3, JC 537·0], S 3·29. (Hipkins.) July, 1878, London. Harmonium at Covent-garden opera. See A 441·2.

EA 447·7 [MA 445·1, JA 443·7], C 532·4 at 59° F., S 3·29. (Ellis.) 1877, Gloucester Festival organ, built by Messrs. Walker, and subsequently removed to Brecon; tuned especially at 64° Fahr, to a fork sent by the organist, Mr. Lloyd, Mus.B. Cantab, which measured C 537·16 at 59° Fahr. Hence the organ pipe was C 535·16, at 64° Fahr, and, consequently, C 532·4 at 59° Fahr. my standard temperature.

(1) A 448·0, EC 532·8 [MC 536·0, JC 537·6] S 3·31. (Delezenne.) 1854, Paris. Opera Comique, as determined by reeds; sold as giving that pitch, for which there is no other authority.

(2) A 448·0. (Lissajous, in Fr. Com.) 1858, France, Paris; Grand Opera.

(3) A 448·0. (Fr. Com.) 1859, Belgium, Liège. Pitch stated by M. Dussoigne-Méhul, director of the Conservatoire, to be the same with that of Paris. He wished to adopt this pitch, as the extreme limit, to prevent further advance.

(4) A 448·0. (Fr. Com.) 1859, France, Lyons, Opera, stated to be the same as Paris. M. Georges Hainl, conductor of the orchestra at Lyons, thought the Paris pitch should be retained, although it was so high, lest the brilliancy of the orchestra might be impaired. This shows how merely orchestral the pitch had become.

(5) EA 448·0 [MA 445·4, JA 444], C 532·8. (Ellis.) 1877, London. Copy made by Mr. Hipkins of a fork shown to him at the Society of Arts Rooms as their standard, but different from Griesbach's. See EA 449·4.

(6) A 448·0. (Schmahl.) 1839-40, Germany, Hamburg. Opera under Krebs.

(1) A 448·1, EC 532·9 [MC 536·0, JC 537·7], S 3·32 (Fr. Com.), 1859, Germany, Munich, Opera. Fork apparently sent by Kapellmeister, Franz Lachner, who was warmly in favour of a settled pitch.

(2) EA 448·1 [MA 445·5, JA 444·1], C 532·9, S 3·32. (Ellis.) 1878, London. Fork in the possession of Messrs. Bishop, made by Walker. No other note.

A 448·2, EC 533·1 [MC 536·2, JC 537·9], S 3·32. (Ellis.) 1869, Germany, Leipzig, Gewandhaus Concerts. Fork sent officially to the Society of Arts, and lent for measurement.

A 448·3, EC 533·1 [MC 536·2, JC 537·9] S 3·32 (Delezenne.) 1854, Paris, Opera, as determined by reeds, sold as giving opera pitch. They beat slowly with the Lilie theatre fork, see A 450·5, There is no other authority for this pitch.

(1) A 448·4, EC 533·25 [MC 536·42, JC 533·1] S 3·33 (Lissajous, cited by de la Fage.) 1857, Berlin Opera. Fork sent by Herr Taubert, conductor of the Opera at Berlin, to the French Society of Pianoforte-makers.

(2) EA 448·4 [MA 445·8, JA 444·4], C 533·3, S 3·33. (Ellis.) 1860, London. Fork purchased at Messrs. Cramer and Co., the authorised agents of the Society of Arts, stamped "Society of Arts, C 528 vib. per sec." Another copy sold by Cramer measured C 531·1, and I observed that most of the copies showed me beat 1 or 2 in a sec. with one another. (See also (2) A 445·1, 445·7, 449·4, 450·3.) A fork bought at the same time as the first, and stamped "A eq. tempt. to C 528 vib. per sec. Society of Arts," was exactly A 448·4, and hence was an exact EA to this C, but not to C 528, which would give EA 444.

A 448·8, EC 533·7 [MC 536·8, JC 538·5], S 3·34. (Fr. Com.) 1859, Leipzig. Fork apparently sent by Herr Ferdinand David, director of the Leipzig Conservatoire, who expressed himself strongly in favour of a uniform pitch as "putting an end to many doubts, annoyances, and even caprices."

A 449·0, EC 533·96 [MC 537·13, JC 528·8], S 3·35. (Lissajous, Bull. Soc. Enc. liv., 1854.) 1855, Paris, Opera. Experiments made by Lissajous and Ferrand, a first violin at opera. It is stated that Marloye could find no fork or fixed pitch of the French Grand Opera.

A 449·2, EC 534·2 [MC 537·4, JC 539·0], S 3·36. (Hipkins.) June, 1877, London. Pitch of the harmonium at Covent-garden opera. (See A 441·2.)

(1) EA 449·4 [MA 446·8, JA 445·4], C 534·46, S 3·37. (Ellis.) 1860, London. Fork made by Mr. J. H. Griesbach, for the Society of Arts, to represent its proposed standard, 1 C 528. The box containing it has the note:—"The pitch of the fork producing the note 1 C [in musical notation], 528 vibrations in a second, was obtained by my apparatus, for registering and printing the vibrations of strings, shown at the Exhibition of the Society of Arts, 1860." See Art. 13 above. Lent by the Society of Arts; a poor fork, which can scarcely be counted for 10 secs., quite unfit to be a standard. See A 445·7 and 448·4.

(2) A 449·4, EC 534·4 [MC 537·6, JC 539·3], S 3·37. (Ellis.) 1869, Germany; Dresden Opera. Fork sent officially to the Society of Arts, as representing the pitch of the Dresden Band, by the late Kapellmeister Rietz, who, at the same time, says that the Dresden pitch is A 446. Both are apparently errors. Herr Moritz Fürstenau, the librarian, says that no such pitch was ever used at the theatre, and sent me his official fork, A 437·8 (see A 438·9), which he believed to be A 440. Herr Rietz apparently transcribed the pitch A 446 (which see) from Näke, and sent by mistake a Leipzig Gewandhaus fork (see A 448·2). But the fork is officially sealed, and hence I feel bound to insert it. Lent for measurement by the Society of Arts.

A 449·7, EC 534·8 [MC 538·0, JC 539·7], S 3·38. (Hipkins.) 1879, London; Opera, Covent-garden. Pitch of the band during actual performance. Taken by beats with a measured fork while the organ A was held to tune from (see A 441·2 and 445·6).

A 449·8. EC 534·9 [MC 538·0, JC 539·7], S 3·38. (Fr. Com.) 1859, Prague ; Opera.

(1) **EA 449·9** [MA 447·2, JA 445·8], C 535, S 3·39. (Ellis.) 1877, London. Copy made for me by Mr. H. Keatley Moore, of Messrs. Moore and Moore, of the Standard fork used by Messrs. Collard, supposed to be meant for the Society of Arts pitch (see A 449·4, 448·4, 445·7).

(2) **A 449·9**, EC 535·0 [MC 538·2, JC 539·8], S 3·39. (Hipkins.) 1878, London ; Covent-garden Opera. Pitch of the band during actual performance (see A 441·2 and 449·7).

(1) **A 450·3**, EC 535·5 [MC 538·7, JC 540·4], S 3·40. (Lissajous, cited in Fr. Com.) 1856, Milan ; Opera.

(2) **EA 450·3** [MA 447·6, JA 446·3], C 535·5, S 3·40. (Ellis.) 1880, London. Copy by Mr. Allen, of Percy-street, of Society of Arts standard, lent me by Mr. Blaikley, of Boosey's.

A 450·5. EC 535·6 [MC 538·8, JC 540·6], S 3·40. (Delezenne.) Lille, 1848 and 1854 ; Opera. From forks tuned by M. Colin, Oboist, during the performance of "Robert le Diable," 27 April, 1854, between the acts, and carefully verified. It was on the occasion of measuring this fork, that Delezenne ascertained the importance of having a string on his sonometer, which was as thin as could bear the strain of tuning. Using strings of ·6154 and ·1280 millimètres in thickness, he found that the lengths which gave the unison to the fork were 203·8 mm. on the first, and 198·9 on the second. The former gave a pitch of V 439·645, and the latter V 450·4776. He, therefore, believes that the thickness of the string produces an error of V 10·8326, or S 0·42. (Lille, mém. 1854, p. 1.)

EA 450·6 [MA 448·1, JA 446·7], C 536, S 3·41. (Ellis.) 1877, Glasgow ; Public Halls. From the fork settled by the organist, W. T Best, and the late Henry Smart, organist and composer, as the pitch for this very fine organ, erected by Messrs. T. C. Lewis and Co., of Brixton, lent me by Messrs. Lewis. This is, apparently, a rather sharp Society of Arts fork, and is nearly up to concert pitch.

A 450·8. EC 536·0 [MC 539·2, JC 540·9], S 3·42. (Wieprecht, cited by Fr. Com.) 1858, Germany, Berlin ; Opera. Original statement not found.

A 451·0. EC 536·3 [MC 539·5, JC 541·2], S 3·43. (Mahillon.) 1879, Bruxelles. The standard for brass instruments made for the Belgian army, by V. Mahillon. The fork sent to me, sold commercially, was A 451·9, and as M. Mahillon could not guarantee its exactness, I have entered the pitch as it exists theoretically. A large fork sent to Dr. W. H. Stone was A 451·7. The pitch was said to have been originally determined by an optical method of which I do not know the details.

(1) **A 451·5.** EC 536·9 [MC 540·1, JC 541·8], S 3·45. (Lissajous, in Fr. Com.) 1858, Russia, St. Petersburgh ; Opera. The tuning-fork sent by M. de Lwoff, master of the court and director of the Imperial Chapel at St. Petersburgh, was a C fork, from which this A must have been calculated, and as the three C forks of Broadwood were misinterpreted as A's by the Fr. Com., there is some doubt of this also. M. de Lwoff was strongly against a high pitch, and considered that it greatly deteriorated stringed instruments by imposing thin strings on them.

(2) **A 451·5**, EC 538·17 [MC 540·12, JC 541·8] S 3·45. (Naeke.) 1862, Germany ; Berlin Opera. Naeke does not speak confidently, as if he had measured it.

(1) **A 451·7**, EC 537·4 [MC 540·4, JC 542·0], S 3·45. (Lissajous, from de la Fage.) 1867, Milan ; Scala Theatre. Fork communicated to A de la Fage, by the director of the Journal *L' Union Instrumentale*.

(2) **EA 451·7**, [MA 449·1, JA 447·7], C 537·2, S 3·45. (Ellis.) 1878*a*, London. Fork in possession of Messrs. Bishop, marked C Philharmonic, possibly meant for the same pitch as A 452·5.

A 451·8. EC 537·2 [MC 540·4, JC 542·1], S 3·46. (Fr. Com.) 1859, Berlin ; Opera.

A 451·9. EC 537·4 [MC 540·6, JC 542·3], S 3·46. (Ellis.) 1878, London. British Army Regulation. Pitch for wind instruments, from a fork sent by Dr. W. H. Stone.

A 452. EC 537·5 [MC 540·7, JC 542·4], S 3·46 (Fr. Com.) 1859, Lille Conservatoire. Apparently the fork sent by M. Victor Magnien, director of the Imperial Academy of Music, a branch of the Paris Conservatoire.

EA 452·5 [MA 449·9, JA 448·5], C 538·2, S 3·49. (Ellis.) London, 1852-1874. Mean of the pitch of the Philharmonic Band, while under the direction of Sir Michael Costa, 1846-1854 ; tuned, in 1859, by Mr. J. Black, of Broadwood's, from records made by Mr. Hipkins. Retained as Broadwood's highest pitch till 1874, when the pitch was sharpened at the instance of Mr. Charles Hallé, see EA 454·7. This was London, No. 3, of the French Commission of 1859, where it is given as A 455, showing an inaccuracy of measurement, calculation, or printing. The copy of this fork, prepared for the Society of Arts in 1860, was C 538·1.

A 452·9. EC 538·6 [MC 541·8, JC 547·2], S 3·50. (Ellis.) 1878, London ; Kneller-hall Training School for Military Music. From a fork lent by Dr. W. H. Stone. The fork belonging to Messrs. Boosey, horn-makers, lent by their manager, Mr. Blaikley, gives A 452·5, the difference, ·4 vib., is merely a difference of fork-makers. Messrs. Boosey also used a fork C 538·2, which is in close agreement with the calculated EC above.

A 453·0. EC 538·7 [MC 541·9, JC 543·6], S 3·50. (Schmahl.) Glückstadt, in Holstein. Organ built 1645 ; improved by Schnitger, 1665 ; examined by Herr Schmahl, in 1879, who found A between V 445 and 444·5, at 4° R. = 41° F, giving A 453·3 or A 452·8, at 59° F, for which I have selected 453 as a mean. This cannot be distinguished in intention from Lehnert's *positiv*, A 455·2, although it is 8·09 flatter.

EA 453·4 [MA 450·7, JA 449·3], C 539·2, S 3·52. (Ellis.) London. Copy by Mr. Allen, of Percy-street, of a fork used by Sir M. Costa, at Covent-garden Opera ; date unknown. Sent me by Mr. Blaikley, of Messrs. Boosey.

EA 453·9 [MA 451·2, JA 450·0], C 539·8, S 3·54. (Ellis, at 59° F.) London. Concert organ pitch of Mr. Henry Willis, to which are tuned the large organs of the Albert Hall, and Alexandra Palace. This important pitch, writes Mr. H. Willis to me, "was arrived at by actual and continued observation of the pitch of orchestras, especially when there was no organ to embarrass it." It gives C 543·2 at 65° F, for which Mr. Willis estimated it at C 541. At 61·5° F, when I measured the pipe, it was C 541·2, precisely the same as Albert Hall when measured by Mr. Hipkins (see A 455·1). Mr. Willis builds all his concert organs to this pitch, thus re-establishing the old difference between chamber (= concert) and church pitch, for which see A 445·2.

A 454·0. EC 539·9, [MC 543·1, JC 544·8], S 3·54. (Naeke.) 1862, Austria, Vienna. Piano of Kapellmeister Esser, while the orchestra was at A 466, the fork at A 456·1, and the piano of the other Kapellmeister at A 445 ; see those pitches.

EA 454·1 [MA 451·4, JA 450] C 540, S 3·55. (Ellis.) London, Feb., 1877, Crystal Palace. From a fork in Mr. Hipkin's possession, tuned under his direction to the piano supplied for the Crystal Palace concerts of that day. N.B.—This is the pitch wrongly attributed to the Philharmonic of that date in my former paper, Soc. Arts *Journal*, 25th May, 1877, p. 683, under C 544·3. Dr. Stone had an A fork, made to the same band in March, 1877, which I measured by Appunn as A 458, and on reducing 7·6 per thousand, this will become A 454·6, agreeing very closely with the above, but the fork having been lost, I have been unable to re-measure it.

A 454·2, MC 543·4 [JC 545·0, EC 540·2], S 3·55. (Ellis.) 1715*c*, England, London. Very old fork, of the same shape and workmanship as Mr. Driffield's tenor A (see A 419·9), but S 1·36 sharper. It is nearly as sharp as the highest London pitch in 1879. Found in Myatt's market gardens, Brixton, March, 1878 (gravelly subsoil), when the land was cleared for building, and given me by Mr. Hipkins. There is no impressed mark upon it ; but it was written on with ink, and this has left a rust mark. The whole fork is, however, so rusty, and the surface of the iron so disintegrated, that it is difficult to discover what was meant. To the naked eye there seems to be LA on one side, and A on the other, and I have adopted this theory ; but under a magnifying-glass, the letters seem to disappear. It is exactly a mean-tone large semitone sharper than A 424·5, that is, it would coincide with a mean tone B *flat* on an organ of that pitch, and it seems, therefore, intended to be a semitone higher than the ordinary pitch of the time, the semitone being necessarily taken large in order to agree with a note on the organ. It thus became a higher chamber pitch, and would seem to establish the existence of such a pitch in England. See notes on the two organs at the Franciscan Church at Vienna, under A 457·6. On account of its very rusty state it may have flattened a little, but certainly not more than V 4 in V 1,000, or V 1·8 ; see above Art. 10. Supposing it had suffered to this extent, it would be A 456, or MB *flat* to A 426·2, which is almost precisely the original pitch (A 425·9) of Jordan and Bridges organ, at St. George's Chapel, Great Yarmouth.

(1) **EA 454·7** [MA 452·0, JA 450·6], C 540·8, S 3·57. (Ellis.) Unknown date, London. Copy made for me by Mr. H. Keatley Moore, of Messrs. Moore and Moore, of a fork at Messrs. Collard's, used by Sir M. Costa at Covent-garden Opera, several (unknown) years ago.

(2) **EA 454·7**. (Ellis.) London, July, 1874. Fork representing the highest pitch of the Philharmonic concerts, observed by Mr. Hipkins ; tuned under his directions. Used as Broadwood's highest pitch since 1874, at the suggestion of M. Charles Hallé (see EA 452·5).

(3) **454·7**. (Ellis.) London, 1879. Fork lent by Messrs. Steinway, as showing the pitch to which their London pianos are tuned.

(4) **EA 454·7**. (Ellis.) London, 1878. Messrs. Bryceson's band pitch, to which they tune their high pitch organs. They, however, also tune in French pitch. St. Michael's, Cornhill, which was rebuilt by Messrs. Bryceson, was tuned to this pitch.

EA 455·1 [MA 452·4, JC 451·0], C 541·2, S 3·58. (Hipkins and Ellis.) May, 1877. Wagner Festival at Albert Hall, giving, therefore, the pitch of the Albert Hall organ. Observed by Mr. Hipkins with a fork measured by me ; temperature probably 61½° Fahr. (see A 453·9). Dr. Pole, on the delivery of my first paper, May 23, 1877, said he had just been dining with Herr Wagner, who "complained bitterly of the inconvenience his singers had been put to, on account of the fact that the pitch they were obliged to sing to here was so much higher than that which they were accustomed to." For Munich pitch see A 435·4 ; for Vienna see (2) A 446·8 ; these were the chief places the singers came from.

EA 455·2, EC 541·3 [MC 544·5, JC 548·7], S 3·59. (Schmahl and

Ellis.) 1749, Hamburg; an old chamber organ, or *positiv*, built for a bürgermeister by Lehnert, in possession of Herr Schmahl, who took the pitch by forks, which I measured and reduced, as 2 B *flat* 483·9 and 1 C *sharp* 572·8; these are only S 2·92 apart, which may be possibly an equal minor Third out of tune. The two measurements give respectively EA 455·8 and 454·6, of which I have taken the mean, which is S 1·90, or very nearly one equal tone sharper than St. Michaelis, Hamburg (see A 407·9), and almost exactly in accordance with present English concert pitch.

A 455·3, EC 541·5 [MC 544·7, JC 546·4], S 3·59. (Ellis.) London, 1879. Fork lent by Messrs. Erard, as representing their concert pitch.

A 455·5, EC 541·7 [MC 544·8, JC 596·6], S 3·59. (Fr. Com.) 1859, Belgium, Brussels; band of the Guides (see A 451·0). Apparently the fork sent by M. Bender, musical director to the King of the Belgians, and of the regiment of Guides. M. Bender was in favour of two standard pitches, one for military music, and another a quarter of a tone lower for theatres, and he put this in practice himself (see (2) A 442·5). He considered the Guides pitch unsuited for vocal music.

EA 455·9 [MA 453·2, JA 451·8], C 542·2, S 3·62. (Ellis.) 1877, London. From a fork lent by Dr. W. H. Stone, copied from one used by one of Messrs. Chappell's tuners. The fork was a very poor one, and its beats could not be counted for more than four secs., hence there is a possible error of V 0·5.

(1) EA 456·1 [MA 453·4, JA 452·0], C 542·4, S 3·62. (Lissajous, from de la Fage.) London, 1857. Sent by M. Bettini, director of music at the London Italian Opera to the (French) Society of Pianoforte-makers. There is no English corroboration for this pitch so early as 1857, and it has even now not been reached.

(2) A 456·1, EC 542·4 [MC 545·6, JC 547·3], S 3·62. (Ellis.) 1859*a*, Vienna. Fork kindly tuned for me by Messrs. Streicher, pianoforte-makers, of Vienna, from a fork in their possession, giving the orchestral pitch of Vienna, the celebrated "sharp Vienna pitch," in use before the introduction of the French Diapason Normal. See end of notes on (2) A 422·3.

EA 457·2 [MA 454·5, JA 453·1], C 543·7, S 3·66. (Ellis.) 1879, New York. Fork obtained from New York by Messrs. Steinway, to show the pitch to which they tune their pianos there. See A 454·7, for their English pitch, which has been assimilated to Broadwood's.

7. *Church Pitch, High.*

A 457·6, C 544·7, EC 544·2 [MC 547·4, JC 549·1], S 3·68. (Ellis.) 1640c, Austria, Vienna. Great Franciscan organ, which, in Herr Ullmann's notes, is stated to be 240 years old in 1878, and to possess its original pitch (*ihre Urstimmung*). It is only used for leading the ecclesiastical chants ("zur Führung des Kirchengesanges"), the original use of these high organs. Comparing its pitch with that of the Brixton fork, A 454·2, and the notes there, it seems probable that the original pitch of the smaller organ in this Franciscan church, may have been that of a MA 427·7 = the MB *flat* on this higher instrument, which would have allowed the two instruments to be played together by transposing a semitone. Afterwards, and for the same reason, when the higher organ was put into equal temperament (the actual C of the instrument is 544·7, in place of the correct 544·2 given above), the MB *flat*, 427·7, would have become EB *flat*, 431·9, which, taken as A, may have been the pitch of the lower instrument. Even after the lower pitch had been raised to A 442·7, as at present, Herr Ullmann says, that the higher instrument is half a Tone above the lower, though the difference is now only ·57 eq. sem., that is, very nearly a quarter of a tone, and, consequently, the organs can no longer be played together. The real intention of the lower instrument was clearly to introduce the lower concert pitch (Kammerton) at half a note lower, so as to be capable of playing the two instruments together. The pitch is derived from two forks tuned for me by organ-builder Ullmann, as A 454·4 and C 540·9 at 98 R, which reduce, as above, at 59° F.

A 466·0 EC 554·2 [MC 557·5, JC 559·2], S 3·99. (Näke.) 1862, Austria, Vienna. The highest pitch known to Naeke. But see A 456·1. In a letter of 27 Aug., 1878, to Mr. Hipkins, Herr Streicher, the great Vienna pianoforte-maker, says:—"The reason why Herr Karl Naeke makes the pitch much higher than the fork I sent you, may be simply that, in former years, the orchestra of the Opera House practically played a strong beat higher than the usual fork, as is also practically the case now. At present, the French Diapason Normal passes for being the official fork; but, practically, the real pitch is a strong beat sharper than the official fork." See (2) A 446·8 for this practical pitch, and for similar phenomena, at Covent-garden Opera, see A 445·6 and 449·7, and (2) A 449·9. Hence we must take this as an extreme pitch, partly caused by the warmth of the house. See A 424, for another instance.

A 474·1, MC 567·2 [JC 568·9, EC 563·8], S 4·29. (Ellis.) England, 1668. Tomkins.—(Dr. Armes.) 1683, Bernhardt Schmidt's organ, at Durham Cathedral.—(Ellis.) 1708, B. Schmidt's organ, at the Chapel Royal, St. James's Palace.—(Ellis.) 1708 to 1748, the Jordans's organ, at St. George's, Botolph-lane. To begin with the second. In Feb., 1879, I measured an old A pipe at Durham, as A 443·1 (which see). Since that time, Dr. Armes, the organist of Durham, has examined every pipe and board of the old instrument, and discovered that, as originally built, it was a 16 F organ; and that shortly after, two "quarter-tones," namely, A *flat* and D *sharp*, were added to G *sharp* and E *flat*, as on the Temple organ (written, however, as two G *sharps* and two D *sharps*, in Schmidt's own hand, still legible). In 1815, as Dr. Armes thinks to be most probable, the pipes were shifted a whole tone, and the organ made a 16 G organ. In this case, one of Schmidt's G *sharps* was made into an A, and the other into B *flat*, and two new pipes were added, which Dr. Armes now has, so that the compass which extended originally to ½ C, was raised to ½ E. The pipe I measured as 2 A, was a 2 G *sharp* in the old organ, and that gives the pitch at the head of this article. That is, the organ was originally a great semitone sharper than it was when Bishop dealt with it. The B *flat* pipe I saw, which was exactly a foot long, was, therefore, originally an A pipe; that is, the Durham was an A foot organ; and this leads directly to Tomkins's pitch. In the preface to Rev. Sir F. A. Gore Ouseley's "Collection of Sacred Compositions of Orlando Gibbons, 1873," he quotes from the end of a list of errata appended to the "Pars Organica" of Thomas Tomkins's "Musica Deo Sacra," "published in 1668, but composed for the most part before the time of the Commonwealth," the note "*f* [meaning 4 F] *sit tonus fistulæ apertæ longitudine duorum pedum et semissis; sive* 30 *digitorum geometricorum*" [let the pipe 4 F be 2½ ft. or 30 in. in length]. This note, Sir F. Ouseley informs me, in a private letter, "occurs in an extra page of errata at the end of the 5th volume, or 'Pars Organica.' I have reason to believe," he continues, "that it must have been a subsequent insertion after many copies of the work had been printed off, as it does not occur either in the Bodleian copy, or the copies preserved in the British Museum and the library of Christ Church, Oxford, which I have collated." In the preface, already cited, he observes that "an open pipe two feet and a-half in length will not produce our modern F, but a somewhat sharp G, so that it is plain that, by transposing the Church music of that period upwards of a whole tone, we are, in fact, restoring it to that which was intended by the composer." This estimation of the pitch of Tomkins's F is slightly incorrect. Tomkins's F was Handel's G, being the modern concert F sharp; that is, Tomkins's was only a semitone sharper than our present concert pitch, a circumstance of importance as respects the conclusion drawn from Tomkins's rule for Orlando Gibbons's pitch, on which see A 567·3, towards the end, where it appears that his pitch may have been much sharper still. On the Durham organ, however, such a pipe as Tomkins described existed, the resulting pitch being a great semitone sharper than Schmidt's Hampton-court pitch, which might always be obtained by shifting the pipes of the sharper organ, although it was, most probably, original at Hampton-court. The sharper pitch was a whole tone sharper than Handel's. At this time, however, there was a still further reduction of a whole tone below Schmidt's usual pitch, used at Trinity College, Cambridge (see A 295·2). Now Tansur (b. 1700), having a son a chorister at Trinity College, Cambridge, and writing in 1745 ("New Musical Grammar," by W. Tansur, for the use of which I am indebted to Mr. Herrman Smith), says (p. 57), "Our *new Consort Pitch* is more fitter for *vocal performance* than the *old Consort Pitch*, which is half a *tone* lower," probably showing one of these changes. Even B. Schmidt himself may have used one of these flatter pitches for chamber organs, for Mr. C. A. Bishop informs me that he remembers "cutting down" such an organ to Smart's pitch, A 433·2, which, of course, implies that the organ may have been as flat as Handel's A 422·5, or a tone below B. Schmidt's higher pitch. Now the following note (for which I am indebted to Mr. Ebenezer Prout), makes it probable that there were two pitches current in England about or before 1714. "In a version of one of the Chandos anthems (Chrysander says earlier), written for the Chapel Royal, and published by the G.H.S. [German Handel Society] for the first time, called "O sing unto the Lord a new song," the air, "Sing unto the Lord and praise His name" is in Handel's MS., in the key of E minor; but, as in this key the voice part lies very high, a note is added in the composer's handwriting, intended for the copyist. 'This verse must be transposed a tone lower in all parts—*in the organ part two tones lower.*" This, of course, ought to imply that the organ was one tone too high. Which Chapel Royal was intended does not appear. The Chapel Royal, Whitehall, was burned in 1698, and the banquetting-hall, in which was B. Schmidt's organ, was opened as a Chapel Royal in 1715, but I am told that no anthems were performed there. I think, however, that this organ was very probably as sharp as the Durham one, as it was the first B. Schmidt built in England, 1662. Elliott, in 1814, removed all the old pipes of this organ, except a few stopped wooden ones, and tuned it to the flat pitch (Handel's) then in vogue. It was stored away from 1827 to 1837, and then re-erected without alteration. But, in 1844, the swell was added, and the pitch raised to that of Hampton-court. This information was given me by Mr. T. Hill. Nothing, therefore, can be learned of the original pitch of this organ. The old organ of St. James's Chapel Royal was also built by B. Schmidt, in 1708, and erected, after his death, by his son-in-law and successor, Christopher Schreider, in 1710. This organ remained in the chapel till 1837, when it was removed to a private chapel in Long-acre, and thence it was removed and set up in the chapel of Mercers-hall by Robson in 1868. This organ I measured and examined on 25 February 1880. The pitch at 59° F. gave C 529·1, B 498, A 442. Supposing the C to be right, we should have MB 494·4, MA 442·2, and EB 499·4, EA 444·9. Hence the organ was very imperfectly tempered, but assuming that C 529·1 was right, we have MA 442·2 as its pitch, which is practically that of Hampton-court A 441·7. After measuring, I examined the marks on several pipes of the prin-

cipal on the great organ, and found that it had been shifted a great semitone; thus, the old B *natural*, B *flat*, C, D, D *sharp*, had become new C, B, C *sharp*, D *sharp*, E, respectively. The old marks were quite distinct and of the old form, the D and D *sharp* in particular being the German old forms used by Praetorius. The shifting was effected probably more than 100 years ago, as the newer markings had every mark of age. This, then, pretty well established the fact that B. Schmidt or Chr. Schreider made organs in this sharp pitch as late as 1708-10. Also, as I am told that Handel constantly played upon this very organ, it seems not improbable that his note to the copyist referred to it. At the same time, the probability of the Whitehall Banquetting-hall organ having been as sharp, is strengthened. Purcell, 1658-95, was organist there, and also at Westminster-abbey, organ built by Schreider and Jordan in 1730. Now, Sir F. A. Gore Ouseley says, in a private letter:—"To illustrate the variations of pitch, it would suffice to compare together the sacred and secular vocal music of English composers from Gibbons to Blow, *i.e.*, throughout the 17th century. In the case of Purcell, what tenor could possibly sing 'Come if you dare' or 'Britons strike home' at the pitch indicated in Tomkins's book? Or what bass could possibly have sung his 'They that go down to the sea in ships' [which has a scale from 2 D to 8 D in the key of D] if the pitch had been so low as the forks of that period indicate?" But Handel wrote both higher and lower, and Mozart as low. Now, as to Westminster, I put it flat in (2) A 422·5 as the earliest pitch I could find. But this organ of St. James's Chapel Royal makes a high pitch probable for Schreider, one of its builders; and the organ built by Jordan in St. George's, Botolph-lane, shows that the other of the two builders of Westminster-abbey organ also used a sharp pitch. This organ was rebuilt by Mr. T. Hill, and he found it so sharp that he was obliged to shift the pipes a semitone down, that is, to make the old C his C *sharp*, in order to bring it approximatively to his own pitch, which is that of Hampton-court; this, of course, means taking B *natural* as C, and this pitch gives MB *natural* 526·7, Mr. Hill's being C 525·3, so that they are practically identical. But perhaps this may belong to the series of organs represented by the Brixton fork A 454·2. I beg to express my obligations to Rev. Sir F. A. Gore Ouseley, Dr. Armes, Messrs. Ebenezer Prout, T. Hill, C. A. Bishop, Herrman Smith, R. Massey (late of Whitehall Chapel Royal), C. S. Jekyll (of St. James's Chapel Royal), and N. W. B. Collyer (of Mercers-hall), for their assistance in conducting this difficult investigation. In order to compare the series of English organs which existed in England, I give the pitches of their 12 notes in mean tone temperament, assuming, not the pitches as determined by actual measurement, but the pitches as derived from Handel's fork. 1. Is the pitch of Trinity College, Cambridge (see A 395·2), here derived as a mean Tone below (3). 2) Is Handel's pitch derived from his own fork (see A 422·5). 3) Is the pitch of Hampton-court Organ derived as a great semitone below (5). 4) Is the Brixton Fork pitch (see A 454·2), here derived as a great semitone above (2). 5) Is the pitch of this article, here derived at a mean Tone above (2). It will be seen that these pitches agree practically with those found by measurement, and it will also be seen what kind of errors are introduced by shifting, and have to be corrected by the organ-buildor.

Mean Tone Notes.	1. Trinity College.	2. Handel.	3. Hampton-court.	4. Brixton.	5. Durham.
2 C	236·2	252·7	264·1	270·4	282·5
2 C *sharp*	246·8	264·5	276·0	282·6	295·2
2 D	264·1	282·5	295·2	302·3	315·9
2 E *flat*	282·5	302·3	315·9	323·5	330·1
2 E	295 2	315·9	330·1	338·0	353·2
2 F	315·9	338·0	353·2	361·7	369·0
2 F *sharp*	330·1	353·2	369·0	377·9	394·9
2 G	353·2	378·8	394·9	404·4	422·5
2 G *sharp*	369 0	394·9	412·6	422·5	441·5
2 A	394·9	422·5	441·5	452·1	472·4
2 B *flat*	422·5	452·1	472·4	483·7	493·6
2 B	441·5	472·4	493·6	505·6	528·2
1 C	472·4	505·4	528·2	540·8	565·1

A 480·8. C 575·3 [MC 575·1, EC 571·8, JC 577·0], S 4·54. (Degenhardt and Ellis.) 1879, Germany, Hamburg; St. Catherinen Kirche. This organ was built by Hans Stellwagen in 1543, and has been frequently repaired. Herr Schmahl (see A 489 2) thinks it hardly possible that it should have kept its original pitch. But Herr Degenhardt, the organist, himself assures me that, even at the last repairing, 1867-9, the pitch was never altered. It must, however, be considered doubtful, as there is no proof that it may not have been somewhat altered in olden times. The pitch was taken for me by Herr Degenhardt, by tuning-forks at 15·2° R., and subsequently reduced. It is V 8·4, or S 0·30 flatter than old St. Jacobi at Hamburg, A 489·2, but possibly they were meant to be in the same pitch. A to C forms an almost exact mean-tone minor Third. But the C was tuned from the Choir Organ (*Oberwerk*) and the A from the Great Organ (*Hauptwerk*), and the C may have been tuned too sharp by Wolfsteller, as the temperament is intentionally equal. Herr Schmahl says that this wide minor Third, A to C, results from the method of tuning used by Wolfsteller, in which A was tuned first and C last, and became faulty, as his Fifths and Fourths were too nearly just. This was the case as early as 1840-48, so that the major keys of F *sharp* and D *flat* were better tuned than those of C and G on this organ.

MA 483·7 [JA 480·6, EA 485·6], MC 578·6 [JC 576·6, EC 577·5], 1 G 865·13, S 4·64. (Ellis.) 1790, Padua. A fork preserved in the Institute "di Fisica" of the Royal University, at Padua, and copied for me exactly, under the direction of Sig. Fr. Rossetti (see A 425·2 for references). It was inscribed *Sol*. The original was probably made under the direction of Signore Stratico, professor of mathematics and naval science at Padua, from 1764, and of physics also from 1777 to 1798, for the purposes of his excellent essay on qualities of tone (Mem. dell' I.R. Inst. del. regno Lomb. Veneto, years 1814 and 1815, pp. 171—218). It is the fork No. 1 of the memoir of Prof. Zantedeschi. Prof. Zantedeschi cites it as an example of the instability of tuning-forks, supposing that it must have been originally 1 JG 768 to 2 C 256, and finding by ear that it agreed with 1 A of Colbacchini's pitch-pipe (really V 844·4 or S 0·42 flatter), which he also believed to be 1 JA 853·3, 2 C 256, he supposed that the fork must have gained V 85$\frac{3}{4}$. There is no reason whatever for supposing this fork to have been originally at a lower pitch. This 2 G 432·56 is very nearly the French A 435·4, compare A 484·1. Whether Stratico took it from any existing organ or not does not appear, so that we cannot be certain that it represented an acknowledged Italian pitch.

A 484·1, EC 575·7 [MC 579·1, JC 580·9], S 4·65. (Jimmerthal.) 1878, Germany; Lübeck Cathedral, smaller organ. Herr Jimmerthal, the organist, says that in summer, at 16° R. (68° F.), the new great organ by Schulze is at French pitch, and the old small organ has then its 2 G in unison with the 2 A of the other. The above has been calculated from these data. But Herr Jimmerthal adds that 30 years ago the old organ was a few beats (*einige Schwebungen*) lower. Possibly, therefore, it originally agreed with St. Catherinen Kirche, Hamburg (see A 480·8) Herr Jimmerthal considers that the old organs in Lower or Northern Germany are tuned thus high, out of economy.

EA 489·2 [MA 490·2, JA 488·7], EC 581·8 [MC 586·4, JC 586·4], 2 E 366·5, S 4·84. (Schmahl and Ellis.) 1688, Germany, Hamburg; St. Jacobi Kirche. This organ was built in 1688-93, by Schnitger, of Harburg, in Hanover, and afterwards of Hamburg, an admirer of Werckmeister, who in his *Orgelprobe* (2nd edition, 1698); says that he can only recommend equal temperament. Herr Schmahl, the organist (see authorities), says that he has no doubt that the organ was originally tuned in intentional equal temperament, although actual equal temperament was not produced till Scheibler's discoveries. There is no mention in the archives of the organ, which Herr Schmahl has searched for the purpose, of any alteration of tuning, and the organ was in intentional equal temperament when he became the organist in 1838, and he never recollects having heard of any other but intentional equal temperament in the North of Germany; and his master, Demuth (d. 1848), of St. Catherinen Kirche (see A 480·8), whose memory extended to 1810, also could recollect no other but such equal temperament. Of course, the temperament was never perfectly equal, and when Herr Schmahl practised on the St. Catherine's organ, the usual keys of C, G major, &c., were not so good as the unusual F *sharp* and D *flat*. In 1720, J. S. Bach played on St. Jacobi organ, and, according to Bitter's life of Bach, expressed himself very pleased with the tuning, and as J. S. Bach is known to have favoured intentionally equal temperament, this is another resoning for calculating the pitch from 2 E on that hypotheses. It is even reported that J. S. Bach applied to be organist to this organ, but was defeated by a clerical competitor of mediocre powers, who advanced some money for the purpose. The pitch of 2 E was determined by an old pipe preserved in the organ case, which was found to beat flat four times in a second, with 2 E on the organ as now tuned, for which see A 494·5. From this all the other numbers are calculated. Observe that this old pitch is almost exactly one equal tone sharper than the modern French pitch. There is an old peal of bells in the church which is just a little flatter than the modern pitch, and probably agrees with the old pitch. There does not appear to have been any special music written for this high pitch, at least Herr Schmahl does not know of any, and he is accustomed, on the organ as now tuned, to transpose everything at sight a tone lower. Hence, probably, the traditional reason for the old high pitch had died out before this organ was built, though it was retained in the old High Church pitch, or very nearly so. But this organ originally possessed one stop, an 8-foot Gedact, which was in the chamber pitch a minor Third lower (or EA 411·4, JA 407·7), as shown by the church archives for delivery in 1693, and renovation 1721. In 1761 this stop was replaced by an 8-foot Gamba in the pitch of the other stop. This is the only instance I have met with of both church pitch and chamber pitch on the same organ. On this subject, Herr Schmahl refers to Niedt's "Handleitung zum General-Bass," vol. 2, 1720, by Mattheson, which I have not seen. The organs at Altona and St. George's, Hamburg, both by the same maker, are at the same pitch

An old tuning fork, now belonging to Herr Schmahl, but formerly to two or three generations of singers at St. Catherine's, Hamburgh (see A 480·8), was exactly in French pitch. It would seem, therefore, probable that modern French pitch was at one time a chamber pitch corresponding to this St. Jacobi as a high church pitch, but in that case there was another chamber pitch a semitone lower (see A 407·9).

8. *Church Pitch, Highest.*

A 494·5, C 587·9 [EC 588·1, MC 591·6], S 5·02. (Schmahl and Ellis.) 1879, Germany, Hamburg; St. Jacobi Kirche. Present pitch, determined by beats, counted by Herr Schmahl, made with forks measured by me, all reduced to 59° F. This pitch was given to the organ in 1866, in order to agree with Scheibler's tempered forks, and is a little sharper than the original pitch, for which see A 489·2. The ragged state of the ends of the pipes necessitated their being trimmed, and had not the organ been sharpened in 1866, it would have been necessary to piece all the pipes, which was not considered advisable.

A 495·5, CE 589·3 [MC 592·7, JC 594·5], S 506. (Schmahl.) 1700, Germany, Rendsburg in Holstein, a tolerably large organ recently broken up, which was measured by Herr Schmahl as G 434 at 7·5° R, giving the above on reduction to 59° F. As the organ was very dusty, it is possible that the true pitch was higher, and may have reached that of the Halberstadt organ, A 505·8.

MA 503·7 [JA 506·8, EA 505·6], MC 602·5 [JC 600·7, EC 601·4], G 450·5, S 5·34. (Ellis.) 1636, Paris. Mersenne's church pitch, with the 8 G on the four-foot French pipe, having V 112·6. (See A 376·6 and "Harmonie Universelle," livre 3me., "Des Instruments à Chordes," p. 147; livre 3me., "Des Mouvements and du Son des Chordes," p. 169.) Mersenne observes that this is the lowest note of his own voice, and that only the deepest and bassest voices in France can descend a Fifth, to the 8 C 75·3 below. Now, in my observations, I found only 16 out of 141 basses who could get so low as this, although 17 others of this number reached 8 D 76, and 15 others got lower still. (See A 567·3.) This, therefore, agrees with Mersenne's statement His own voice, reaching to his 8 G 112·6, or, in Broadwood's medium pitch, to 8 A 111·6, would be, probably, a rather low tenor. (See the tables in Art. 21.) This sufficiently confirms this very high French church pitch, which is nearly identical with that of Halberstadt A 505·8, and about a Tone higher than Broadwood's medium pitch A 446·2, although I can find no mention of such a high French pitch elsewhere.

MA 504·2 [JA 505·0, EA 507·2], C 603·2, S 5·35; pressure, 3½ in. (Ellis.) 1511, Heidelberg. Schlick (see MA 377·0) recommends a pipe 6½ Rhenish feet long, as either 8 F, or as 8 C, a Fifth deeper. I have assumed the diameter to be one-sixteenth of the length, and the very close approximation of the pitch to that of Halberstadt (see MA 505·8), confirms the conjecture.

JA 505·8 [MA 508·9, EA 506·9], JC 606·9 [MC 608·8, EC 602·9], 4 B 284·5, 64 B 17·78, S 5·41, pressure 3¼ inches. (Ellis.) Germany, Halberstadt Cathedral Organ, built 1361, repaired 1495, described by Praetorius ("Syntagma Mus.," vol. 2, pp. 97–99, 101–4), who saw it, and gives the name and dimensions of the largest pipe as B *natural*, 31 Brunswick feet long, and 3½ Brunswick feet in circumference. A Brunswick foot has 285·36 mm. This, therefore, makes the pipe 8846 mm. long, and allowing 1·5 mm. for the thickness of the metal, 314·8 mm. in diameter. Taking a sixteenth of these lengths, we obtain for 4 B, 552·9 mm. long, and 19·7 mm. in diameter. I had a pipe constructed 555 mm. long, and 19·86 mm. in diameter, which, under pressures of 2¾ and 3¼ inches spoke V 282·5 and V 283 respectively. Correcting these numbers by the rule in Art. 8, by multiylping each by 1766·5 (= 3 × 555 + 3 × 20·3), and dividing by 1757·2 (= 3 × 552·9 + 3 × 19·7), we obtain 4 B 284 and 4 B 284·5 respectively. I have assumed the latter as most probable, and calculated the above numbers accordingly. The smaller pressure gives JA 504·9, JC 606·5. The difference is unimportant. It is probable, however, that the very narrow pipe constructed may be slightly flatter than four octaves above 64 B, so that the extreme sharpness of the result is certainly not exaggerated. Praetorius says that we see by the pipes that the pitch is a good Tone, nearer a Tone and a half above what he considers the suitable church pitch, which A 505·8 really is (see A 424·2). This 64 B would have been practically inaudible, but, being accompanied by numerous other pipes in a "mixture," became effective.

9. *Chamber Pitch, Highest.*

MA 563·1 [JA the same, EA 567·6], MC 673·6 [JC 675·7, EC 675·2], 2 F 450·5, S 7·26. (Ellis.) 1636, Paris. Mersenne's Chamber Pitch, "Harmonie Universelle," liv. 3, des instruments à chordes, p. 143, where he says:—"La voix ou la note la plus grave de la basse [of a certain song] est F-ut-fa [=8 F], et parceque ceux qui font la basse dans la chambre, ne vont pas ordinairement plus bas qu'un tuyau d'orgue de 4 pieds ouvert, il s'ensuit que la plus basse note" of the air answers to the note of that pipe, which (see A 373·7 and 376·6) I take to be V 112·6, whence follow all the above numbers. Now, Mersenne gives as the lowest note of a small organ which he had at hand (*quam præ manibus habeo*), the equivalent of a 2-foot pipe (see the reference under A 373·7). It seems, therefore, probable that it was an organ in chamber pitch, similar to that formerly belonging to Christian IV., of Denmark (died 1648), figured by Praetorius ("Syntagma Musici," Sciographia, plate I.), and also described (*Ibid*, vol. ii., p. 80) which proceeded from 8 F to 1 A, having 38 keys, only Mersenne's was an octave smaller, with only 26 keys, possibly 8 F to 1 A, to which he would sing an octave lower, and thus reach his own lowest note, that of the 4-foot pipe (see A 503·7). This is the pitch which Mersenne assumes for his scales (*Ibid*, p. 146), only he takes 8 F 96 in place of 8 F 112·6, owing to his faulty measurement of the pitch of his 4-foot pipe (see A 373·7). See confirmation of this remarkably high pitch in A 567·3.

MA 567·3 [JA 570·8, EA 570·7], C 678·7, 8 C 84·84, S 7·40. (Ellis.) 1619, North German church pitch, called by Praetorius chamber pitch. This is corroborated by that of Mersenne A 563·1. It is, however, advanced with considerable hesitation. Praetorius ("Synt. Mus.," vol. ii., p. 30) gives a table of the compasses of the several voices, marking the notes reached with ease and with difficulty. On p. 19, he says, "It must be here, first of all, *in genere*, remembered, that, in the whole of this work" [meaning his table of compasses of the voice and instruments] "everywhere throughout, the Instruments and Voices are not reckoned and arranged by Church Pitch but by Chamber Pitch, as we have already explained that some very properly distinguished it." This refers to *ibid.*, p. 15, where he says that, in Prague, and some other Catholic Bands (*Kapellen*), pitch is divided into church pitch and chamber pitch in such a way that "the present common pitch, by which almost all our organs are now tuned, is called chamber pitch, and used only for table and convivial purposes; and this is most convenient for instrumentalists, on account of the wind and stringed instruments. But church pitch, which is a whole Tone flatter, is used only in the churches; first, to enable the vocalists, on whom the greater labour falls in the churches (especially in Catholic churches, on account of the long duration of psalm-singing, &c.), to manage better with their voices, and not be rendered so rapidly hoarse by the sharpness; and next, because the human voice, in its middle and lower regions, is much more pleasant and charming than when it has to shout and scream in its high parts, beyond its power. Hence, *propter alias etiam multifarias commoditates, suavitem singularem ac concentus benè susceptos*, it would be better for all our organs to be tuned and built a Tone or Second deeper. But it is quite impossible to make this change in Germany, and, consequently, we must retain our present chamber pitch (which is now commonly called church pitch in most places)." Now, it would seem almost from his recommending this reduction of a Tone, that the high pitch he speaks of was only a tone above the "suitable pitch," which he himself proposes (see A 424·2), and this would give A 474·3, which is Tomkins's pitch (see A 474·1), and not nearly so high as the existing Hamburg pitch (see A 489·2), or the old Halberstadt pitch A 505·8. In commenting on this last, Praetorius says ("Syntagma Mus.," vol. 2, p. 102):—"This (Halberstadt) organ, and similar work, was a good Tone, nearly a Tone and a-half higher than our present organs, which are suitable for church purposes [*als die unsrige itzige Chormessige Wercke stehen*, a peculiar phrase indicating those in his own 'suitable' pitch], which are shown by the length of the great pipes already cited. And it is, therefore, also probable that long previously, all organs, whether of the size already described or not, may have stood in the same pitch, or even higher, because, during the time of Popery, they were only used for the *choral* [ecclesiastical tones]. Forasmuch as finally the *choral* organs, *which were made a whole Fourth higher or a Fifth lower than our pitch* [meaning the 'suitable' pitch, A 424·2?] were recognised as the most convenient, and were kept to this pitch. And although some organs are deficient, and do not exactly agree with the pitch just described, this defect is not to be attributed to the good will and diligence of those masters who originally built the old choral organs which are still [1619] in use, but is probably due to their not having at that time selected a constant chorist or church tone [*Choristen- oder Chor-Thon*], as, thank God, is now usual. Also the organs to which good choristers [*chorales*] and screaming voices are engaged, and are present to sing, are often tuned a tone higher or lower, and also by much renovation and tuning have been sharpened considerably above their original condition. Otherwise the above-described pitch, namely, one a Fourth higher or a Fifth lower (in reference to our present usual pitch, otherwise called chamber pitch), is considered to be the most correct, and still so found in the churches of the principal ecclesiastical foundations. And yet many organs will also be found which are a Second [a Tone] lower or higher, and some—not a few—are also tuned and built a semitone higher." This passage seems to imply a general ancient pitch, which was a Fourth higher than Praetorius's own "suitable" pitch. But his language is so confused that, though I have studied it for months, I cannot pretend to be certain. A meantone Fourth above A 424·2 would be A 567·3, as here suggested. But, as I have found no existing trace of such a pitch in Germany, I have endeavoured to deduce his chamber pitch from the account of the compass of the human voice which he gives, and for this purpose, mainly, I made the series of observations recorded above in Art. 21, and with the tables there given, and Mr. Randegger's statements, should be compared the following, given by Praetorius ("Syntagma," vol. ii., p. 20):—

	Easy Limits.	*Extreme Limits.*
Soprano	2 C to 1 E or 1 F.	2 B to 1 G or 1 A.
Alto	4 F to 2 G or 2 A.	4 E to 2 B *flat*.
Tenor	8 B or 4 C to 2 E.	8 A to 2 F.
Bass	8 C to 4 A or 4 B *flat*.	16 F, 16 G, 16 A or 16 B to 2 C or 2 D.

The Sopranos are described as "Eunuchus, Falsetista, Discantista," and the Alto was the male alto, or counter tenor; and these were not the kind of voices I tried, except, perhaps, in the bass falsetto. Hence the real comparison can only be made in the Bass and Tenor. As regards the extreme limits of the bass, I heard a high pitch 16 B 63·3, from 13, and a high pitch 16 A 56·3, from 2 out of 141 basses. But 16 F, 16 G, were quite beyond any one. Praetorius ("Syntagma," vol. ii., p. 17) quotes only from hearsay that three voices in a Munich choir reached that 16 F "in a strong full voice." If we suppose that 16 F to have been 16 B *flat* 56·7 of Praetorius's suitable pitch, it would be the lowest conceivable pitch for a man to sing clearly. If, then, we assume this to be the value of his 16 F, or take 2 F 453·9, we find A 567·3. But an argument cannot well be founded on such an extremely exceptional case. Praetorius makes 8 C an *easy* note for the Bass. Now, out of 141 basses, I found only eight who could reach a high pitch 8 C 67·6 with ease. It is, therefore, quite out of the question to put the easiest note of the bass so low. The mean easy bass limit was 8 E 81·2, or, 8 E in French pitch. But it would be wrong to call this mean easy for all voices, when at least 49 basses out of 141, that is, more than one in three, could not reach it. But only 24 out of 141 basses could not reach 8 F 84·8, which is the 8 F to Praetorius's "suitable" pitch A 424·2. This, therefore, may be called easy, although about one in six cannot reach it. It is, however, nearly a semitone lower than the 8 F 88·6, which Mr. Randegger assigns as the limit. Hence, I cannot be assigning too high a value to the 8 C of Praetorius's easy bass limit by making it 8 C 84·8, but this gives as before 2 A 567·3. Now, if we adopt this value of A, we should find for Praetorius's easy limits of bass 8 C 84·8 to 4 A 287·6 or 4 B *flat* 321·5, that is, in Broadwood's medium pitch (A 446·2) adopted by Randegger 4 E 83·6 to 2 C *sharp* 281·1, or, 2 D *sharp* 315·5, which are rather low bass limits, according to my observations, so that there is no exaggeration in assuming the chamber pitch of Praetorius's limits to have been a whole Fourth higher than his "suitable" pitch, as the quotation given above seems to imply. The tenor then, would have in Praetorius the limits, 8 B 158·5, or 4 C 169·6, to 2 E 424·2, or in Broadwood's medium pitch from 4 E *flat* 157·8, or 4 E 167·2, to 2 G *sharp* 421·2, which certainly gives a very high lower limit, and a rather low upper limit to the tenor, but still a compass larger than the smallest found in my observations. Praetorius's tenor compass of an Octave and a major Third or Fourth is very small indeed; hence, so far as the bass and tenor voice are concerned, this extraordinarily high pitch accords with the other indications given by Praetorius, and hence I venture to assign it to North Germany. I was much inclined to suppose that Praetorius must have meant the pitch of his tables of compass to have been only a minor Third above his suitable pitch, agreeing with the Halberstadt organ. But to assume a tone lower would give such an impossible "easy" compass to the bass, that I felt obliged to renounce it. A comparison of Praetorius's upper limit of his voices with that used by Orlando Gibbons in England (1583-1625, that is contemporary with Praetorius) is very singular. Rev. Sir F. A. Gore Ouseley, in a private letter to me (16 May, 1878), states that he, who has thoroughly examined and published an edition of O. Gibbons's works, "knows of only three instances in which he wrote 1 E, his usual limits being, for sopranos, 1 D; for altos, 2 A; for tenors, 2 F or 2 E; and for basses, 2 C." Now Praetorius's upper limits are for Sopranos, 1 E or 1 F; for Altos, 2 G or 2 A; for Tenors, 2 E; and for Basses, 4 A or 4 B *flat*, easy, with 2 C or 2 D as extremes. It will be seen that these are practically identical with O. Gibbons's usage. The necessary inference is that the Church pitch for which he wrote was identical with this high Church pitch (confusedly called chamber pitch) of Praetorius. In his madrigals, on the contrary, O. Gibbons uses higher notes. Sir F. A. Gore Ouseley says, "in the madrigal of 'The Silver Swan' he takes his trebles up to 1 G, and in others he takes his altos to 1 C, his tenors up to 2 G, and his basses up to 2 E *flat*." This clearly indicates that Gibbons's chamber pitch was a tone to a minor Third flatter than his church pitch. Assuming his church pitch then to be A 567·3, his chamber pitch would be A 507·3 (practically identical with Halberstadt A 505·8), if we took it a Tone; or A 474·1, which is the old pitch of Durham Organ, and of Tomkins, if we took it a minor Third, flatter than his church pitch. This would seem to imply that Tomkins's pitch, thought to be extremely high, was really a much flattened pitch, the original cause of the sharpness, the Roman Catholic ecclesiastical tones having practically ceased to exist in England with Elizabeth's establishment of the Reformation in 1588. The following extract from Praetorius bears upon old English pitch, and confirms its former extreme sharpness, as also the high German pitch ("Syntagma," vol. ii., pp. 14–15):—"The ancient church pitch was about a Tone lower and deeper than at present, which may still be seen on old organs and other wind instruments [this may refer to Halberstadt, and making that organ a Tone lower than was usual when Praetorius wrote, would give the higher pitch, as above], and afterwards, from year to year, it was as much raised as is now usual in Italy and England, and in the princely bands of Germany. Although the English pitch on instruments is a very little (*ein gar geringes*) lower, which may be seen on their trumpets and shawms (*Zincken und Schalmeyen*), or oboes, as they call them, which are there manufactured." He proceeds to speak of an attempt to raise the pitch by a semitone, which he deprecates, on account of singers, especially altos and tenors, and also because stringed instruments could scarcely bear the then strain, so that strings constantly snapped, for which reason it was better to play such instruments a tone lower, which he says is a great assistance to vocalists.

TABLE II.

Classified Index to Table I.

Arrangement.—The countries are arranged in alphabetical[1] order:—1. Austro-Hungary; 2. Belgium; 3. England; 4. France; 5. Germany; 6. Holland; 7. Italy: 8. Russia; 9. Spain; 10. United States of America.

Under each country, the pitches are classified as—1. Standards; 2. Old Forks; 3. Church Organs; 4. Concert Organs; 5. Operas; 6. Concerts; 7. Pianos; 8. Military Music; 9. Other Instruments.

The Pitch is always that of A, with merely a sufficient description to recognise it. For full details, the A must be looked out in Table I., which is arranged in numerical order. But the S, or number of equal semitones and cents (see Art. 5), by which the pitch is sharper than A 370, is annexed, in order that, by the difference of their S, the relative sharpness of the pitches may be immediately ascertained.

In each division, the towns are generally placed together, and the pitches for each town are arranged chronologically, as far as was practicable—the letter after the date meaning *a*, *ante*, or before; *c*, *circa*, or about; and *p*, *post*, or after; thus, 1800*c* is about 1800, 1800*a* is before 1800, 1800*p* is after 1800.

The mark ,, means that the date or name in the preceding line is to be repeated. The mark ——— in the date or place column shows that the date or place is unknown. When the date is unknown, the pitches are placed in order of sharpness.

Date.	Place.	Pitch.	S	A
		I.—Austro-Hungary.		
		3. Church Organs.		
1640*c*	Vienna	Large Franciscan Organ	3·68	457·6
1780	,,	Organ-builder Schulz.....	2·25	421·3
1878	,,	St. Stefan	3·13	443·2
,,	,,	Small Franciscan Organ.....	3·11	442·7
		5. Opera.		
1823	,,	Näke (Euryanthe)	2·90	437·5
1834*a*	,,	Scheibler I.	2·76	433·9
,,	,,	,, II.	2·86	436·5
,,	,,	,, III.	2·98	439·4
,,	,,	,, IV.	3·01	440·3
,,	,,	,, V. (Blahetka)	3·04	441·1
,,	,,	Scheibler's Streicher's Fork ...	3·13	443·2
,,	,,	Scheibler VI. (monstrous growth).....	3·21	445·1
,,	,,	Vienna Old Sharp Pitch.....	3·62	456·0
1862	,,	Näke, sharpest	3·99	466·0
1878	,,	Ullmann	3·27	446·8
1859	Pesth	From Fr. Com.	3·23	446·0
,,	Prague	,, ,, ...	3·38	449·8
		6. Concerts.		
1845	Vienna	Marloye (Conservatoire)	3·21	445·4
		7. Pianos.		
1780	,,	Stein, for Mozart	2·26	421·6
1862	,,	Esser, per Näke.....	3·54	454·0
,,	,,	Proch ,, ...	3·20	445·0
		9. Other Instruments.		
,,	,,	Sellner's Oboe, per Näke	2·80	435·0
		II.—Belgium.		
		1. Standards.		
1876	Brussels	Meeren's Proposed Concert Standard	2·75	432·0
1879	,,	Mahillon's Army Standard ...	3·43	451·0
		5. Opera.		
1859	,,	Bender's Pitch	3·10	442·5
		6. Concerts.		
,,	Liège	Conservatoire.....	3·31	448·0
		8. Military Instruments.		
,,	Brussels	Band of Guides (Fr. Com.) ...	3·59	455·5
		III.—England, Scotland, and Ireland.		
		1. Standards.		
1842	London	Hullah's C 512 = 524·8	3·05	441·3
1860	,,	Society of Arts intended C 528	3·16	444·0

Date.	Place.	Pitch.	S	A
1860	London	Griesbach's Soc. Arts C	3·37	449·4
,,	,,	,, ,, A	3·22	445·7
,,	,,	Cramer's ,, A and C	3·33	448·4
1877	,,	,, ,, (Bishop's)	3·20	445·1
,,	,,	Mr. Hipkins's copy of Soc. Arts	3·31	448·0
,,	,,	Allen's ,, ,,	3·40	450·3
1877*a*	,,	Tonic Sol-fa College 1 JC 513	2·50	427·5
1877*p*	,,	,, ,, 1 JC 507	2·30	422·5
		2. *Old Forks.*		
———	,,	Faraday's 2 C, 2 A *flat*, 2 E *flat*, 2 A	2·37	424·3
———	,,	,, 2 G	2·62	430·3
———	,,	,, 1 C and 2 E	2·67	431·7
———	,,	,, 1 C and 1 E	2·72	432·8
———	,,	,, 2 A	2·89	437·2
———	,,	Ellis's 2 A Philharmonic	,,	,,
———	,,	Bishop's 2 C, found in organ	3·01	440·4
———	,,	Ellis's 1 C Philharmonic	3·16	444·2
1715*c*	,,	Rev. Mr. Driffield's 4 A	2·19	419·9
,,	,,	Fork found buried at Brixton, 2 A	3·55	454·2
1751	,,	Handel's own Fork 2 A	2·30	422·5
1800*c*	,,	Broadwood's 1 C	2·31	422·7
,,	Plymouth	Dr. Stainer's 2 A	2·38	424·6
,,	London	Cavaillé-Coll's English 1 C	2·94	438·5
,,	,,	Broadwood's 1 C	2·33	423·6
,,	,,	,, 1 C	2·49	427·2
,,	,,	de la Fage's 2 A	2·50	427·5
1826*c*	,,	Broadwood's 1 C	2·50	427·5
,,	,,	,, 1 C	2·54	428·4
1846*c*	,,	Bryceson's 1 C	2·70	432·3
,,	,,	Ellis's 2 C	2·71	432·6
,,	,,	,, 1 C	2·75	433·7
1849*a*	,,	Irish Gentleman's 2 A Philharmonic	2·80	435·0
1878*a*	,,	Bishop's Walker's 1 C	3·32	448·1
,,	,,	Bishop's 1 C Philharmonic	3·45	451·7
		3. *Church Organs.*		
1668*a*	,,	Tomkins's rule	4·29	474·1
1669	,,	B. Schmidt's original Whitehall ?	,,	,,
———	,,	,, altered ,,	3·08	441·7
1683	Durham	,, Original Organ	4·29	474·1
1815*p*	,,	,, altered	3·12	443·1
1879*a*	,,	Willis's New Organ	3·18	444·7
1690	Hampton Ct.	B. Schmidt, Chapel Organ	3·08	442·0
,,	,,	,, Old Pipe	3·07	441·7
1708	London	,, St. James's Chapel Royal, original	4·29	474·1
———	,,	,, altered, A 442, see A 474·1	———	———
1759	Cambridge	,, Trin. Coll. after shifting	1·14	395·2
	Temple	,, see under A 422·5		
1666	Worcester	T. and R. Harris, Cathedral	2·89	437·1
1670	Newcastle	R. Harris, St. Nicholas	2·55	428·7
1696	London	,, St. Andrew Undershaft	2·51	427·7
1700	,,	,, St. John's, Clerkenwell	2·15	419·0
1878*a*	Norwich	,, ? Cathedral	2·49	427·2
1778	London	Green, St. Katherine's, Regent's-park	2·33	423·2
1780	Winchester	,, Restoration of College Organ	2·20	420·1
1788	Windsor	,, St. George's Chapel	2·51	427·8
1790	Kew	,, Parish Church	2·30	422·6
———	Dublin	,, Trinity Coll., restored ?	2·87	436·8
1696	Boston, Linc.	,, Christian Smith, restored ?	2·95	438·9
1749	London	Glyn & Parker, All Hallows the Great and Less	2·37	424·3
1720	Westminster	Schreider and Jordan's, Abbey original (?) see under A 474·1	———	———
1820*a*	,,	,, altered	2·30	422·5
1821	,,	,, altered for Greatorex to A 433·2		
1848	,,	,, altered by Hill to A 441·7		
1877	,,	,, present state	2·92	438·0
1740*p*	London	Schnetzler, German Chapel Royal	2·42	425·6
1764	Halifax	,, Parish Church	,,	,,
1740	Gr. Yarmouth	Byfield, Jordan, and Bridge, St. George's Chapel	2·44	425·9
,,	,,	,, Parish Church, restored ?	2·91	437·7
1748	London	Jordans', St. George's, Botolph-lane	4·24	474·1
1830*c*	Belfast	Christchurch, restored ?	2·75	433·6
,,	Arundel	Parish Church	2·82	435·6
1838	Bath	Smith, of Bristol, Abbey	2·30	422 5
———	Fulham	Jordans', Parish Church, altered ?	2·62	430·4

Date.	Place.	Pitch.	S	A
1840*a*	Paddington	St. Mary's Chapel	2·95	439·0
1840*c*	Shrewsbury	Byfield and Green, St. Mary's, altered ?	2·75	433·6
1843	Wimbledon	Walker, Parish Church	2·46	426·5
1855	Barking	Byfield and Green, restored by Walker (originally A 474·1)	2·98	439·5
———	Salisbury	St. Edmund's	3·14	443·7
———	London	St. George's-in-the-East	,,	,,
1877	,,	St. Paul's, present state	3·18	444·6
1878	,,	Bryceson, St. Michael's, Cornhill	3·57	454·7
1879*a*	Salisbury	Willis, Cathedral	3·20	445·2
,,	Glasgow	,, Established Church Cathedral	,,	,,
,,	Edinburgh	,, Episcopalian Cathedral	,,	,,
1878	London	Bishop's Standard Pipe	2·84	436·0
,,	,,	Gray and Davison's ,,	3·00	440·0
,,	,,	Walker's ,,	3·01	440·2
,,	,,	Bevington's ,,	3·02	440·5
,,	,,	Lewis's ,,	3·04	441·0
,,	,,	Hill's ,,	3·07	441·7
,,	,,	Bryceson's ,,	3·13	443·4
,,	,,	Willis's Church ,,	3·20	445·2
1879	,,	Experimental Copy of R. Harris's B *natural* at All Hallows, Barking	2·79	434·7
,,	,,	Experimental Copy of B. Schmidt's, Hampton-court, B *flat*	3·23	445·8
,,	,,	Narrow scale experimental B *natural* one-foot pipe	3·23	446·0
		4. *Concert Organs.*		
1867	,,	Walker, Exeter-hall	3·23	445·8
1879	,,	,, ,, sharpened	3·28	447·3
1877	,,	,, Gloucester Festival	3·29	447·7
,,	Glasgow	Lewis, Public Halls	3·41	450·6
1877*a*	London	Willis, Concert Standard, Albert Hall, Alexandra Palace	3·54	453·9
,,	,,	Albert Hall, observed	3·58	455·1
,,	Sydenham	Gray and Davison, Crystal Palace	3·55	454·1
,,	London	Bryceson, band pitch	3·57	454·7
		5. *Opera.*		
———	,,	Covent-garden, Allen's copy of Costa's Fork	3·52	453·4
———	,,	,, Collard's copy of Costa's Fork	3·57	454·7
1857	,,	Bettini's Fork of London Opera	3·62	456·1
1877	,,	Covent-garden, Harmonium	3·36	449·2
1878	,,	,, Organ	3·05	441·2
,,	,,	,, Harmonium	3·29	447·5
,,	,,	,, Band during performance	3·39	449·9
1879	,,	,, Organ	3·22	445·6
,,	,,	,, Band during performance	3·38	449·7
1880	,,	,, Theatre Fork for the Season of 1880	2·82	435·4
1878	,,	Her Majesty's, Organ	2·85	436·1
1879	,,	,, Band during performance	3·20	445·5
1880	,,	,, Theatre Fork	3·19	444·9
		6. *Concerts.*		
1813 —28	,,	Philharmonic, copy of original Fork	2·35	423·7
,,	,,	,, another copy	2·33	423·3
1826	,,	Approved by Sir G. Smart 1 C	2·72	433·0
,,	,,	Sir G. Smart's own 2 A	2·73	433·2
1846 —54	,,	Mean of Philharmonic under Costa	3·49	452·5
1874	,,	Highest Philharmonic	3·57	454·7
1876	,,	Sold as Concert-pitch by Cramer	3·26	446·7
1877	Sydenham	Crystal Palace Band	3·55	454·1
,,	London	Wagner Festival at Albert-hall	3·58	455·1
		7. *Pianos.*		
1826	,,	Broadwood's lowest	2·72	433·0
1849 —54	,,	,, medium, original	3·23	445·9
,,	,,	,, ,, copy now used	3·24	446·2
1860	,,	,, ,, copy made for Society of Arts	3·21	445·5
1852 —74*a*	,,	,, highest	3·49	452·5
1874*p*	,,	,, highest	3·57	454·7
1846*a*	,,	Hipkins's Vocal (meantone)	2·74	433·5
1846*p*	,,	,, ,, (equal)	2·84	436·0
1877	,,	Collard's Pitch	3·39	449·9

Date.	Place.	Pitch.	S	A
1879	London	Erard's Pitch	3·59	455·3
,,	,,	Steinway in England	3·57	454·7
1877	,,	Chappell	3·62	455·9
		8. Military Music.		
1878	,,	Dr. Stone's British Army Regulation Fork	3·46	451·9
,,	,,	Dr. Stone's Kneller - hall Training-school Fork	3·50	452·9
		IV.—France.		
		1. Standards.		
1648	Paris	Mersenne's one French foot pipe	0·17	373·7
1766	,,	Dom Bédos's ,, ,,	0·31	376·6
1854	,,	Delezenne's ,, ,,	0·15	373·1
1700*p*	,,	Pitchpipe at Faculty of Sciences	1·78	410·0
1832	,,	De Prony's proposal	3·07	441·7
1834	,,	Marloye's proposal	2·62	430·5
1858	,,	Cavaillé-Coll's proposal	3·16	444·0
,,	,,	French Commission's proposal	2·80	435·0
1859	,,	Diapason Normal at the Conservatoire; under this pitch see complete list of copies examined	2·82	435·4
		2. Old Forks.		
1700*c*	Lille	Mazingue's Old Fork	0·66	384·3
1754	,,	François's ,,	2·30	422·6
1800*c*	,,	Cohen's ,,	2·55	428·7
1854*a*	,,	Delezenne's ,,	2·72	432·9
1859*a*	,,	Marquis d'Aligre's Old Fork	2·97	439·3
1810*c*	Paris	Lemoine's ,,	2·60	430·0
		3. Church Organs.		
1636	,,	Mersenne's *ton de chapelle*	5·39	503·7
1700*a*	Lille	L'Hospice Comtesse	0·19	374·2
1789	Versailles	Palace Chapel, Conservatoire Fork	1·17	395·8
1818	Paris	Tuileries Chapel, ,,	2·78	434·3
1840	,,	Cavaillé-Coll's St. Denis	3·17	444·3
1851*a*	Lille	St. Sauveur	0·69	384·6
1854*a*	,,	La Madeleine (restored)	1·29	398·7
,,	,,	St. Maurice (repaired)	1·66	407·3
,,	,,	St. André ,,	2·69	432·2
1841	,,	St. Etienne (rebuilt)	2·89	437·1
1854	,,	St. Catherine (retuned)	3·02	440·5
		4. Concert Organ.		
1851	Lille	Festival Organ	3·27	446·8
		5. Opera.		
1810	Paris	Grand Opera, Drouet	2·32	423·0
1811	,,	,, Scheibler	2·48	427·0
1819	,,	,, Cagnard de la Tour	2·76	434·0
1822	,,	,, Fischer	2·67	431·7
1824	,,	,, lowered for Branchu	2·43	425·8
1829	,,	,, recovered Pitch	2·76	434·0
,,	,,	,, Cagnard de la Tour	2·92	438·0
,,	,,	,, Orchestral Pitch	3·00	440·0
1830	,,	,, Drouet	2·63	430·8
,,	,,	,, ,,	2·80	435·8
1834*c*	,,	,, Scheibler's Petit-bout	2·76	434·0
1836	,,	,, Cagnard de la Tour	2·88	437·0
1836 —9	,,	,, Delezenne's Leibnei	3·04	441·0
1854*a*	,,	,, ,, Forks	2·89	437·4
,,	,,	,, ,, Pleyel	3·02	440·5
,,	,,	,, ,, Reeds	3·32	448·3
1855	,,	,, Lissajous & Ferraud	3·35	449·0
1856	,,	,, Pianoforte-makers' Fork	3·24	446·2
,,	,,	,, Bodin's Fork	3·23	445·8
1858	,,	,, French Commission	3·31	448·0
1823	,,	Italian Opera, Fischer	2·37	424·2
1829	,,	,, Cagnard de la Tour	2·80	435·0
1836	,,	,, ,, ,,	2·88	437·0
1854	,,	,, Delezenne's Reeds	3·10	442·5
1856	,,	,, Bodin	3·29	447·4
1820	,,	Opéra Comique or Feydeau, Conservatoire	2·32	423·0
1823	,,	,, Fischer	2·50	427·6
1829	,,	,, Cagnard de la Tour	2·92	438·0
1836	,,	,, ,, ,,	2·92	441·0
1854	,,	,, Delezenne's Reeds	3·31	448·0
1859	Bordeaux	Provincial Opera, Fr. Com.	3·12	443·6
1848 & 1854	Lille	,, Delezenne	3·40	450·5
1859	,,	,, French Commission	3·46	452·0
,,	Lyons	,, ,, ,,	3·31	448·0
,,	Toulouse	,, ,, ,,	3·10	442·5

Date.	Place.	Pitch.	S	A
		6. Concerts.		
1636	Paris	Mersenne, Ton de Chambre	7·26	563·1
1812	,,	Conservatoire, Museum Fork	2·98	439·5
1834*a*	,,	,, Scheibler	2·82	435·3
,,	,,	,, ,,	3·03	440·9
,,	,,	,, Scheibler's Gand	2·82	435·2
1856	,,	,, de la Fage	3·24	446·2
1815	,,	De Prony (iron wire)	2·93	438·2
,,	,,	,, (brass wire)	3·18	444·5
1859	Toulouse	Conservatoire, Fr. Com.	2·88	437·0
,,	Lille	,, ,,	3·46	452·0
,,	Marseilles	,, ,,	3·27	447·0
		7. Pianos, Spinets, &c.		
1648	Paris	Mersenne's Spinet	1·48	402·9
1713	,,	Sauveur (see also A 407·1 and 408·0)	1·63	406·6
1783	,,	Pascal Taskin	1·74	409·0
1829	,,	Piano of Opera	2·42	425·5
1836	,,	Wölfel's Pianos	3·13	443·3
1854*a*	,,	Pleyel's Pianos	3·23	446·0
		V.—Germany.		
		1. Standards.		
1619	Brunswick	Praetorius's "Suitable Pitch"	2·37	424·2
1834	Stuttgart	Scheibler's Pitch at the Congress of Physicists	3·01	440·2
		2. Old Forks.		
1740—1812	Eutin	F. Anton von Weber's Fork	2·36	424·1
1780	Dresden	Kirsten's Fork	2·29	422·3
1800	Hamburg	Kummer's Fork	2·39	429·4
		Schmahl's Fork, A 435·4 (see under A 489·2)		
		3. Church Organs.		
	N. Germany	Praetorius (called by him *Chamber Pitch*)	7·40	567·3
1361	Saxony	Halberstadt Organ	5·41	505·8
1511	Heidelberg	Schlick, high Pitch	5·35	504·2
,,	,,	,, low Pitch	0·33	377·0
1543	Hamburg	St. Catherine (taken 1879)	4·54	480·8
1615	Palatinate	Salomon de Caus	1·19	396·4
1645	Holstein	Glückstadt	3·50	453·0
1688	Hamburg	St. Jacobi, low stop, old Pitch	1·84	411·4
,,	,,	,, high stops, old Pitch	4·84	489·2
1700*c*	Holstein	Rendsburg	5·06	495·5
1714	Saxony	Freiberg Cathedral, Silbermann	2·17	419·3
1716	Strassburg	See under A 376·6		
1722	Saxony	Dresden, St. Sophie	2·01	415·5
1749	Hamburg	Lehnert's Positiv	3·51	455·2
1754—1824	Saxony	Dresden, chained fork of R.C. Church Organ	1·99	415·0
1760	Holstein	Rendsburg	5·06	495·5
1762	Hamburg	Mattheson's St. Michaelis	1·69	407·9
1833	Weimar	Töpfer's Pipe	2·37	424·4
1862	Saxony	Dresden, Orchestra of R.C. Church	2·36	424·0
,,	,,	,, the same in the theatre	2·50	427·5
1878	,,	,, R.C. Church Organ	2·12	418·1
,,	Lübeck	Cathedral, Old Organ	4·65	484·1
1879	Hamburg	St. Jacobi, Present Pitch	5·00	494·5
		5. Opera.		
1752	Berlin	Marpurg, Fr. Com.	2·27	421·9
1806—14	,,	Wieprecht, Fr. Com.	2·62	430·5
1822	,,	,,	2·89	437·3
1830	,,	Wieprecht, Fr. Com.	3·00	440·0
1834	,,	Scheibler "trustworthy"	3·07	441·8
1857	,,	Taubert	3·33	448·4
1858	,,	Wieprecht, Fr. Com.	3·42	450·8
1859	,,	Fr. Com.	3·46	451·8
1861	,,	Näke	3·45	451·5
1869	,,	Sent to Society of Arts	2·82	435·5
1815—21	Dresden	Näke's Fork of Weber's time	2·33	423·2
1826	,,	Reissiger	2·80	435·0
1859	,,	Fr. Com.	3·04	441·0
,,	,,	Näke, during performance	3·23	446·0
1862	,,	Fürstenau's official Fork	2·91	437·8
1869	,,	Sent to Society of Arts from Leipzig	2·95	438·9
,,	,,	Rietz's Fork (probably an error)	3·37	449·4
1878	,,	Jehmlich's Fork	2·97	439·4
1859	Brunswick	Fr. Com.	2·78	443·5
1859	Carlsruhe	,,	2·80	435·0
,,	Gotha	,,	3·13	443·3
,,	Weimar	,,	3·19	444·8

Date.	Place.	Pitch.	S	A
1859	Stuttgardt	Fr. Com.	3·12	443·0
,,	Munich	,,	3·32	448·1
1869	,,	Sent to Society of Arts	2·85	436·1
,,	Baden	,, ,,	2·78	434·5
,,	Würtemburg	,,	2·88	436·9
1879	Hamburg	Opera, under Krebs	3·31	448·0
		6. Concerts.		
1714	Saxony	Näke's presumed Chamber Pitch	0·24	375·2
——	Hamburg	Old Orchestral Pitch	3·20	445·0
1859	Leipzig	Conservatoire, Fr. Com.	3·34	448·8
,,	Würtemburg	Fr. Com.	3·19	444·8
1869	Leipzig	Gewandhaus, sent to Society of Arts	3·32	448·2
		9. Instruments.		
1776	Breslau	Marpurg	1·96	414·4
1760 —70	——	Flute by Floth (Näke)	2·12	418·0
1783	——	Grenser's Clarionet (Näke)	2·28	422·0
——	——	Schneider's Oboe (Näke)	1·91	413·3
1800	——	Holtzapfel's Flute (Delezenne)	2·46	426·5
		VI.—Holland.		
		3. Church Organs.		
		The old celebrated Church Organs have all been altered, and I have not succeeded in my attempts to recover their ancient pitch.		
		6. Concerts.		
1859	The Hague	Fr. Com.	3·34	446·2
		VII.—Italy.		
		1. Standards.		
1720	Rome	Pitch-pipes (Dr. R. Smith)	1·14	395·2
1730*c* 1780*c*	Padua	Mean of Pitch-pipes of the Bell-foundry of Colbacchini	2·41	425·2
		2. Old Forks.		
1730*c*	Padua	Colbacchini's low 1 F	1·52	403·9
1780*c*	,,	,, high 1 F	2·30	422·6
,,	Verona	Cavedini's series of Forks	2·29	422·3
1790*c*	Padua	Stratico's 1 G	4·64	483·7
,,	,,	,, 4 G	2·87	436·6
		5. Opera.		
1845	Florence	Marloye	2·87	436·7
,,	Milan	,,	3·26	446·6
,,	Turin	,,	2·99	439·9
1856	Milan	Fr. Com.	3·49	450·3
1857	,,	La Scala (de la Fage)	3·45	451·7
,,	Naples	San Carlo (Guillaume's Fork)	3·19	444·9
1859	Turin	Fr. Com.	3·19	444·8
		6. Concerts.		
1869	Bologna	Liceo Musicale	3·12	443·1
		7. Pianos.		
1839	,,	Tadolini's Fork	2·43	425·8
		VIII.—Russia.		
		3. Church Organs.		
1781	St. Petersburg	Euler	2·11	418·0
		5. Opera.		
1802	,,	Sarti	2·84	436·0
1858	,,	Fr. Com.	3·45	451·5
1869	,,	Sent to Society of Arts	2·83	435·7
		9. Instruments.		
1739	,,	Euler	1·00	392·2
		IX.—Spain.		
		3. Church Organs.		
1785	Seville	T. Bosch's Organ	2·18	419·6
1858	Madrid	Ton de Chapelle	2·18	419·6
		5. Operas.		
,,	,,	Theatre (in 1879, A 435·4)	3·18	444·5
		X.—United States of America.		
		7. Pianos.		
1879	New York	Steinway's Fork	3·66	457·2

DISCUSSION.

The Chairman said that no one could regret the time Mr. Ellis had taken, considering the great interest and importance of the subject, and the very thorough manner in which he had treated it. He could not expect any discussion upon the paper, because, though they were in the habit of discussing opinions, facts of this kind admitted of no discussion. Mr. Ellis had put all his facts on such good authority, that there was nothing to question—they could only receive them with humility as information of immense value. Indeed, he could hardly express his high opinion of the value of the paper. It was a monument of research which would be referred to in future ages as a credit to the musical science of the day. He would only ask the meeting to pass a vote of thanks to Mr. Ellis for his excellent communication.

The vote of thanks was passed unanimously, and the meeting adjourned.

MISCELLANEOUS.

ARTIFICIAL DIAMONDS.

A preliminary notice by Mr. J. B. Hannay, of his successful attempt to produce the diamond artificially, was read at a meeting of the Royal Society on February 26th, 1880.

While pursuing his researches into the solubility of solids in gases, he noticed that many bodies, such as silica, alumina, and oxide of zinc, which are insoluble in water at ordinary temperatures, dissolve to a very considerable extent when treated with water-gas at a very high pressure. It occurred to him that a solvent might be found for carbon; and as gaseous solution nearly always yields crystalline solid on withdrawing the solvent or lowering its solvent power, it seemed probable that the carbon might be deposited in the crystalline state. After a large number of experiments, it was found that ordinary carbon, such as charcoal, lampblack, or graphite, were not affected by the most probable solvents he could think of, chemical action taking the place of solution.

A curious reaction, however, was noticed, which seemed likely to yield carbon in the nascent state, and so allow of its being easily dissolved. When a gas containing carbon and hydrogen is heated under pressure, in presence of certain metals, its hydrogen is attracted by the metal, and its carbon left free. This, as Professor Stokes suggested to the author, may be explained by the discovery of Professors Liveing and Dewar, that hydrogen has, at very high temperatures, a very strong affinity for certain metals, notably magnesium, forming extremely stable compounds therewith.

When the carbon is set free from the hydrocarbon in presence of a stable compound containing nitrogen, the whole being near a red heat, and under a very high pressure, the carbon is so acted upon by the nitrogen compound that it is obtained in the clear, transparent form of the diamond. The great difficulty lies in the construction of an inclosing vessel strong enough to withstand the enormous pressure and high temperature;

tubes constructed on the gun-barrel principle (with a wrought iron coil), of only half an inch bore and four inches external diameter, being torn open in nine cases out of ten.

The carbon obtained in the successful experiments is as hard as natural diamond, scratching all other crystals, and it does not affect polarised light. Mr. Hannay obtained crystals with curved faces belonging to the octahedral form, and diamond is the only substance crystallising in this manner. The crystals burn easily on thin platinum-foil over a good blow pipe, and leave no residue, and after two days' immersion in hydrofluoric acid they show no sign of dissolving, even when boiled. On heating a splinter in the electric arc, it turned black—a very characteristic reaction of diamond.

Lastly, a little apparatus was constructed for effecting a combustion of the crystals, and determining their composition. The ordinary organic analysis method was used, but the diamond crystals were laid on a thin piece of platinum-foil, and this was ignited by an electric current, and the combustion conducted in pure oxygen. The result obtained was, that the sample (14 mgrms.) contained 97·85 per cent. of carbon, a very close approximation, considering the small quantity at the experimenter's disposal. The author proposes to describe fully the apparatus and all analyses in a future paper.

Mr. Hannay wrote, subsequently to sending in his paper:—"I forgot, in the preliminary notice, to mention that the specific gravity of the diamond I have obtained ranges as high as 3·5; this being determined by flotation, using a mixture of bromide and fluoride of arsenic."

Messrs. Jonas Brothers, having written respecting the statement in Mr. Maskelyne's letter, that the process is "hardly less momentous to the arts than to the possessors of a wealth of jewellery" (see *Journal*, February 27th, 1880, p. 289). Mr. Hannay sent them the following answer, which has been printed in the *Times*:—"I do not in the least expect that my discovery will have any effect upon your business, as the cost of producing very small quantities of substance like boart is so great as to relegate the process to a mere laboratory experiment."

ON SILK-PRODUCING BOMBYCES AND OTHER LEPIDOPTERA.

By Alfred Wailly

(Membre Lauréat de la Société d'Acclimatation de France).

(*Continued from page* 232).

III.—Notice on Atticus Mylitta, Antheræa paphia, the Tusser, Tussur, Tusseh, Tussah* Silkworm.

The *Mylitta*, or Tasar silkworm, which is found all over India, and also in Ceylon, is the most valuable of the Indian wild silk-producing Bombyces, and it is extremely polyphagous. In India, it feeds on *Terminalea tomentosa*, *Zizyphus jujuba*, *Lagerstræmia indica*, *Ficus benjamina*, *Carissa*, *Guidia*, and other trees. Last year, in England (where I introduced it for the first time), and also in France and Germany, it has been reared on oak, and, by Mr. P. H. Gosse, on horn-beam.

The various races of *Mylitta* vary considerably in size, according to the different localities where they are found. The cocoons are oval and silvery-white, or yellowish. Some are 2 in. long and $1\frac{1}{6}$ in. in diameter, and even more; others, only about 1 in. in length. The difference in size of the various races of the same species is very likely due to the quality of the foliage they feed upon.

In the forests of the Himalaya and other parts, where the foliage is abundant and keeps fresh, the worms grow to a considerable size; but, in localities where the weather is hot and dry, the foliage withering in a short time, the worms undergo their changes in a shorter time, and, in consequence, form much smaller cocoons.

This, of course, refers to worms living in a wild state; but, should they be reared on trees properly attended to, and kept in good condition, it is possible that the worms of the various races would all produce large cocoons. As a proof of this assertion, I may mention the success obtained in a part of the Bombay Presidency, where the climate is hotter than in the Himalaya Mountains, by Major G. Coussmaker, who, for several years, has reared this species, and obtained cocoons equal in size to those I received last year from Calcutta, and which came from the Himalaya.

The Himalaya race of *mylitta* is *uni-voltine* (single brooded), the moths emerging about the beginning of July; the races from the south of India and Ceylon, like all species of tropical insects, are *poly-voltines* (many-brooded). One of my correspondents in Colombo, to whom I had written for cocoons, in a letter dated 16th January, 1879, says:—"I have some cocoons of *mylitta*, but the moths are emerging."

At the end of June, 1879, I received from Calcutta a small case containing 55 cocoons of the Himalaya race of *Attacus mylitta*, which is one of the largest. The cocoons having been sent too late, the moths emerged on the way, but a few cocoons escaped, from which, in a few days, emerged large and magnificent moths. From the two first couples I obtained two pairings; the other moths were all females.

The couples were placed in small separate cages, and in the open air, under a roof. The first male and female moths, born in the evening, the 6th of July, paired in the night of the 7th, the pairing lasting 42 hours. The pairing of the second couple, which took place the following night, lasted 48 hours. I never had any species of moths the pairing of which lasted so long. I was so anxious about the success of my first experiment with this species that I paid a visit to the first couple in the middle of the night, when I was agreeably surprised to see that success had been obtained, and that in spite of the rather unfavourable weather.

I was afraid of failure after reading a description of *mylitta* in vol. xxxii. of the "Naturalist's Library," edited by Sir William Jardine, in which the writer of the memoir on *mylitta* says that this species cannot be domesticated. This evidently refers to a race of *mylitta* with habits very different to those of the Himalaya race, as it is further stated "this species cannot be confined, for, as soon as the moth pierces the cocoon, it gets away, and the people add that it is impossible to keep it by any precaution whatever." In another part of the memoir, the following extraordinary statement is made:—"I have frequently endeavoured to detain the males of the Jarroo species, and have kept them locked up in a box for that purpose; but, whether they did not like to make free with their female relations, or from what other cause I know not, but I never could obtain a breed in the domestic state; and the efforts of the male to escape were wonderful, and, at last, always effectual." The Jarroo species alluded to is that from which the cocoons are obtained during the coldest month of the year—January.

Although I could not take the above statements in a literal sense, I feared it was impossible, or at least difficult, to cause the Mylitta moths to pair in captivity. Fortunately, the moths of this great and valuable species paired readily, and for a considerable time (a most important thing), and the females laid their eggs for several days without even damaging their wings. Contrary to some small species of *mylitta*, which are restless, the moths of this large race were extremely quiet; they could be taken by the hand and placed anywhere without letting themselves fall. The male moths must have been as quiet as the female, as they were, after the pairings had taken place, as fresh as they were after emerging from the cocoons.

* From the Hindostani *tussurie*, which means shuttle.

The two female *mylitta* laid about 450 ova, all together. These eggs are of a whitish colour, round, rather compressed, generally with two lines encircling them; they are somewhat larger than the eggs of *Yama-mai* and *Pernyi*. Some of the ova are smaller than the others, and very likely they produce the male larvæ.

The hatching of the ova commenced on the 2nd of August. The smaller larvæ, in the first stage, and when just hatched, were light-brown or buff, the larger ones of a greenish tint. In a few days, they all became of a more uniform colour. Round each segment there is a black line. The head and legs of the larvæ are black, and there are black spots on the body.

The second stage commenced on the 10th of August. The larva was then yellow-green; no black lines round the segments; the head and legs, as in the first stage, black or blackish brown; black spots as before.

The third stage commenced on the 17th of August. Larva, fine green; head and legs, as before, black. Dark spines, with base of a brilliant metallic copper colour.

The fourth stage commenced on the 29th of August. From that date, I regret to say, I was obliged to discontinue my rough descriptions of the larvæ, which, up to that time, after thriving admirably without a single fatality, commenced to die, two, three, or more every day, till all were gone within about 12 days—about 60 worms in all. They were fed on oak.

The death of the *mylitta* larvæ I attribute to several causes. The cold weather compelled me to rear them in a room, and I kept them too long under bell-glasses; perhaps they had not a sufficient amount of fresh air, although the large glasses were raised to renew it. After the first stage, it would have been best to rear them entirely uncovered, on oak branches plunged in water, as they did not much wander then. I rear successfully many species under glass, but some of the larger species do best uncovered, with a free ventilation, and better still in the open air.

I fed my larvæ like *Yama-mai* and *Pernyi*, with hard leaves on old oak branches, and, from what I subsequently learnt from Herr Huesmann, it would seem they prefer young and tender leaves, such as those produced by suckers or shoots of the year; but experience alone will teach us the best method of rearing this valuable species. My impression now is that, the foliage being too hard, the worms could not eat sufficiently, and that they were gradually starved.

Mr. P. H. Gosse, writing to me on September 12th, 1879, says:—"My two *mylitta* larvæ are about 3½ in. in length and $\frac{8}{10}$ths in depth. Fine apple green, with a yellow line on each side; upper tubercles, burnished copper; middle and lower tubercles, purple; spiracles, orange; face, dark brown. I have fed them, as many others, on horn-beam (a valuable discovery of mine)."

In a subsequent communication, dated September 30th, 1879, which Mr. Gosse was kind enough to send me, he says, "In reply to your questions, the *mylitta* larvæ I described in the fifth stage, when full-grown. Both have since died. Fatality has attended almost all my species (*pyri*, *cecropia*, *promethea*, *cynthia*, *selene*) except *Hyperchiria io*, which has done very well."

Major G. Coussmaker, in his "Memoir on *Mylitta*," published in 1873, says the larvæ moult five times. From this we must conclude that Mr. Gosse's larvæ were in the last stage but one. Two larvæ I received from Herr Huesmann, on the 29th of October, in the sixth and last stage, were of an enormous size.

Lord Walsingham, to whom I sent them for preservation, kindly wrote to me on October 31st:—"I am much obliged for the two larvæ of *mylitta*. I am sorry to say that I have failed to preserve them satisfactorily, their brilliant pale-green colour being quite impossible to retain, and their size rendering them very difficult subjects."

The larva in its sixth stage was this:—On the back, 18 brilliant copper tubercles, and two rows of small purple spines on each side; a yellow, lateral stripe on each side; head, dark brown.

Major Coussmaker, in the description of his *mylitta* larva says that, "when hatched, it is blackish-brown, with a shining black head, and that, as it increases in size, the colour of the body turns yellow. After the first moult, the head becomes of a blood-red colour; the colour of the body is of a greenish tint, and after each moult it becomes greener." Major Coussmaker adds, "When full-grown, a fine specimen is, at least, 7 in. long and 1 in. in diameter. I have weighed one of these dimensions when 45 days old, and found it to be 371 grains."

From what has been said, it will be seen that the rearing of *mylitta* last year was of very long duration, from the beginning of August till the end of October; therefore, in England, and other northern countries, artificial heat will be required to bring the larvæ to the formation of their cocoons. No success could be obtained in the open air.

But, in southern European countries, such as Spain, for instance, where the *Yama-mai* and *pernyi* oak silkworms are already thoroughly acclimatised and reared in immense quantities, it is to be hoped the *mylitta* will be equally successful.

In August last, I received a letter, dated 27th July, 1879, from Major Coussmaker, from which I shall quote the following passage:—"My system of rearing is very simple and methodical. I keep all my seed-cocoons in a basket, with the pedicles uppermost. At intervals, between 6 and 11 p.m., I look at them, and if I see any moist at the top, I tie them on to a branch of any tree or shrub in my garden, and at daylight I find that the females are paired in the vicinity of their cocoons, while the males have gone away to seek for mates.

"They are left in that condition all day, and at sunset, or when I am going out for a walk, I take the females, let the males fly, and put the females to lay their eggs. The next morning I take the eggs away, and put them into a small box, or something of the kind, safe from rats, mice, and ants.

"In nine days they hatch out, and I put them on to shrubs, over which I put screens of split bamboo. As the worms grow, they eat the shrubs quite bare, while I move the screens as necessary. To facilitate this moving, I have planted my shrubs in hedges, and now it is only a matter of the food and number of worms.

"From a month to six weeks, according to the moisture and luxuriance of the foliage, the worms take to make their cocoons, and, as far as I can see, success seems certain. The plants I use are the varieties of *lagerstræmia*, *Zizyphus*, *terminalia*, and *carissa*. I am not aware as to whether any of these trees can be obtainable in England, or whether the worms will hatch out there. The moths paired and laid eggs in 1874, but did not hatch. I hope that you will be more successful."

To conclude, I will now quote a few short passages from Herr Huesmann's letters to me:—October 15, 1879—"My *mylitta* larvæ are doing very well, but are growing very slowly; up to this day, only four have formed their cocoons, but these are fully as large as the imported ones. Please to consider that my *mylitta* larvæ are exactly the same age as my *selene*, which partly are moths to-day." October 22—"The first *mylitta* larvæ hatched on July the 31st, and commenced to spin on October the 2nd, about half of this long time having been spent in the last stage. I never bred *mylitta* larvæ before, but have seen them reared in Bremen two years ago. The larvæ I saw in Bremen were a good deal smaller than mine, and their cocoons, of which I had some in my possession afterwards, produced very small and mean-looking moths. I fed my larvæ on the common oak, but always picked out young sprigs with large and succulent leaves."

At the end of October the larvæ had not all formed their cocoons.

A. Wailly.

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CULTIVATION OF OLIVE, CAROB, AND MULBERRY TREES IN CYPRUS.

Olive groves in Cyprus are not so numerous as they might be; but isolated trees are frequently to be seen scattered, with carob trees, on the hills adjoining the two great mountain ranges of the island. On the spurs of the Troodos range, and in the northern slope of the range of Kerynia, they almost form a zone, at a height varying from 400 to 700 feet above the level of the sea; and though that locality appears the best suited for them, they are frequently seen also in the plains as well as the sea-shore. Many years must elapse before olive and carob trees yield any considerable profit to planters. But if, for other reasons, as for instance to promote rain, and to improve the climate, it be decided to plant more trees, olive and carob should, by no means, be lost sight of. They thrive well, and grow almost, as it were, spontaneously, in the island, and would yield, in course of time, a fair profit.

Dr. Schmas and Mr. Galizin mention in their report that the inhabitants do not appear to take much care of the existing olive and carob groves. The fruit of the olive is very small, which induces the belief that they are not properly grafted. The inhabitants of the northern slopes of the mountain range of Kerynia seem to bestow a little more care on their olives. In gathering their olives they take at least the pains of shaking, instead of striking, the branches of the trees, as is practiced in Baffo. The only reason that can be assigned for this rough usage is, that the country people of the south are compelled to gather the olives before maturity, fearing that they would be carried away by thieves, and when yet purple, shaking alone is sufficient to make them fall to the ground. It is difficult, however, to find any excuse for the setting on fire, without any apparent reason, olive and carob trees, as witnessed on more than one occasion. The art of extracting oil from olives is far from being fully developed in Cyprus; but even if some better method were introduced, good oil could never be obtained from olives artificially ripened by baking, as practised in Baffo. This branch of agriculture in Cyprus is capable of great improvement. Neither the quality nor the quantity of the oil now taken is such as to admit of exportation; the whole produce, a short time back, was only 103,114 gallons.

The carobs of Baffo are, unlike the olives, better than those of Kerynia, the former having sugar round the seed, and keeping better than the latter, which have but honey. Cyprus is renowned for its carob groves. The tree, unlike that of Malta, has the trunk straight, and is not so knobby. Not being sheltered, winds damage it to such an extent, that in several parts of the island, especially near the sea coast, the bending of the trunks of the trees is taken to indicate the direction of the prevailing winds. The carob of Kerynia is subject to a disease which reduces the inside of the pod to dust. It appears that it attacks, also, the carob on the seashore. Unlike the olive, the carob bears the heat wonderfully, and this accounts for the greater number of carob than of olive groves. Its cultivation, however, bears no proportion to the vast extent of the island, and to the climate, which is so favourable to its growth. The largest production of carobs is in the districts of Limassol, Karpas, and Kerynia. The whole of the produce of the island some years ago was about 5,000 tons, of which about 1,500 tons were exported.

Mulberry-trees are generally cultivated in proximity to villages, for the leaf, which is the food of the silkworm. They thrive well. At Famagusta, or rather at Varoscia, where mulberries are extensively cultivated, it is calculated that a scala yields food for silkworms, producing from 12 to 16 okes of silk a year (from 33 to 44 lbs.). The silk trade, at present, is not in a very flourishing condition, owing to a disease of the silkworm, from the effects of which the island has been suffering for the last 20 years, notwithstanding the change of seed. Cyprus produced formerly between 70,000 and 80,000 lbs. of silk, whilst at present the yearly produce is estimated at from 5,600 to 8,400 lbs. It is for the most part produced in the districts of Famagusta, Baffo, Larnaka, and Karpas. Kythrea also gives a good supply of silk, but of an inferior quality. It is calculated that 10 okes of cocoons give one oke of silk thread.

FISHERIES OF THE ISLE OF MAN.

The Commissioners of Fisheries—Messrs. Buckland and Spencer Walpole—mention that as so much interest attaches to, and so little is known of, the fisheries of the Isle of Man, they think it right to append a particular reference to them in their report upon the Sea Fisheries of England and Wales. With regard to the inland fisheries, the Isle of Man is watered by several rivers, the greatest and most important being the Sulby, a river which rises near the the centre of the island, and flows into the sea at Ramsey. The second most important watershed is drained by the town rivers, the Dhoo, or the Black River, and the Glass, or the Clear River, which unite their waters near Douglas, and give their united names to the thriving capital of the island. The third river of importance is the Neb, which enters the sea at Peel, and the fourth is the Laxey. Other smaller streams drain other parts of the island.

There is no doubt, whatever, that all these streams were, at a comparatively recent period, productive salmon and sea trout rivers. The Laxey owes its name, like the Lax weir, at Limerick, to the salmon with which it abounded; and the Douglas is situated in the parish of Braddan, a word derived from the Gaelic for a salmon. Men who are still alive recollect the period when the salmon fishery of the island was a profitable business. Of recent years this has been in a very unsatisfactory condition. The fishery of the Laxey has been practically destroyed by the well-known mine which takes its name from the river. The fishery of the Neb has also been destroyed by a mine, while the Douglas river is injured by the gas water of the town of Douglas. Pollution makes it impossible to hope that the salmon fisheries will ever recover their former condition. But in addition to the injury done to these fisheries by pollution, they are also suffering from the consequences of unfair fishing. The fisheries are now regulated by an old Act, passed about forty years ago. The Act provides a close time for salmon; it prohibits the use of certain instruments; and it professes to prevent the pollution of rivers. The authorities of the island, however, doubt the possibility of enforcing its provisions, while, in any case, the Act must be a failure, now that there is no machinery for enforcing them. Analogous machinery, however, to that which is provided with the same object in England, might be easily applied to the Isle of Man.

The sea fisheries are also of importance. Peel, the chief fishing port, is one of the principal stations of the herring fishery. It has a fine fleet of first-class fishing-boats, which frequent many of the principal Irish, Scotch, and English fisheries. The boats are fast, handsome, and large, and it is difficult to see a finer sight than the fleet standing out to sea on a summer's evening. The fleet usually repair in the spring of the year to Kinsale, for mackerel fishing. In the summer and autumn the herrings come into the Manx and Irish seas. The fishery is in a satisfactory condition, and there is an almost universal agreement among the fisherman that only one regulation is required, which, however, is of very great importance. A custom has arisen, of late years, for the fishermen to shoot their nets before sunset. The fish, scared by the early shooting of the nets, frequently sink, and the night's fishing

is, in consequence, lost. In addition to the summer fishery for herrings, there used to be a considerable autumn fishery for spawning herrings off the east coast of the Isle of Man. A large so-called coral bank, many miles in length, extends from a spot off Mangold Head, to a spot off Douglas Head, in which the herrings undoubtedly spawn. There used to be a very considerable fishery for these spawning fish. The fishery has now ceased, as the nets used in it are broken by the vast shoals of dog-fish preying on the spawning fisheries. The fishermen declare that in the olden times the shoal of herrings was much larger than it is now, and that, as the dog-fish were always on the outside, they could drift for some miles through the herrings without coming on the dog-fish. They declare that now the shoal is so much smaller that they come more quickly on the dog-fish, and that the nets are then broken. The Commissioners incline to think that the nets are broken, not because the shoal of spawning fish is smaller, but because the nets, which are now made of cotton, are much weaker than the old nets, which used to be made of hemp. On the other hand, it is only right to say that dog-fish, like other fish, are migratory in their movements, and that it is possible that they visit a place for some years, and then leave it altogether. This view is partly confirmed by a tradition in the Isle of Man, that a special prayer was once put up in all the parish churches against dog-fish. It was not possible to obtain a copy of the prayer, but its existence was stated on good authority. If such a prayer was raised in olden times, it is a fair inference that the present plague is not unprecedented. In addition to the herring fishery, which is chiefly carried on from Peel, there is an important hook-and-line fishery for cod conducted chiefly from Ramsey. The Liverpool trawlers fish the great breeding banks of the island, and the bays are fished by small-meshed draft nets, and by fixed trammel-nets. In the island itself the long-line fishing is regarded as the most important of these industries, and the majority of people in the island are prepared to sacrifice all the other kinds of fishing for the sake of the long-line and herring fisheries.

PROVINCE OF THE DOBRUDSCHA.

As the province of Dobrudscha—ceded to Roumania in exchange for Bessarabia—is likely to increase in importance, and, in time, become a valuable acquisition to Roumania, Vice-Consul Stokes gives a short summary of its principal towns and districts, their population and productions. The town of Tultcha and its suburbs contains a population of about 43,000 souls; the surrounding district is exceedingly fertile, producing grain of an excellent quality, but, owing to its limited cultivation and meagre population, only in small quantities. Its other products consist of wool (of a very superior quality), cheese, caviare, and skins; also wine. Its principal imports are rice, coffee, sugar, oil, spirits, cotton goods, glass ware, iron, and tobacco, but all on a limited scale (barely sufficient to meet the requirements of its population), and are principally imported from France and Austria.

The town of Babadagh and its surrounding district contains a population of about 41,000 souls, and possesses an excellent climate and a rich soil, and is supposed to be rich in mineral resources, which are, as yet, totally undeveloped.

Kustendji is divided into three districts, viz., Kustendji, Mangalia, and Hirsova, and the population of the three districts may be computed at about 23,320 souls, composed of Greeks, Tartars, Bulgarians, Roumanians, Armenians, and Turks, who are chiefly engaged in agricultural pursuits. Kustendji possesses a good harbour, and has the advantage of being the depôt of the Rustchuk and Varna Railway, which greatly facilitates the transportation of grain from the interior of the port. The town of Matchin and its suburbs has a population of about 2,200 souls, and it is a good grain-producing district. Medjidie and Cernavoda have a small population of about 8,000 souls, and are, like the others, grain-producing districts. Sulina, situated at the mouth of the Danube, derives its chief importance from the establishment of the offices of the European Commission of the Danube; it also serves as a depôt for a large quantity of grain, which is brought down from the up-river ports for transhipment on board of the larger class of steamers frequenting the port, whose heavy draught of water prevents them from ascending the river. The importance of the trade of the place depends in a great measure upon the depth of the water in the river, as when it is low, say 14 feet, a much larger number of vessels are loaded in the port. It is found more economical, under these circumstances, to send the grain down from the up-river port in lighters, for transhipment, thereby saving the expense of pilotage up and down, and also avoiding the risk of getting ships aground, which frequently occurs when the river is low, and this entails an expense of at least £500 to refloat a ship. As the incoming and outgoing of the whole trade of the Lower Danube, Sulina is a most important transit station, but nothing more; exports of its own produce it has none, and its imports are confined to the strict necessaries of life, for a population consisting principally of the labouring classes, who find their livelihood by loading and unloading ships. The population may be estimated at about 6,000 souls, chiefly Greeks.

The whole of the province of the Dobrudscha may be pronounced fertile, and possessing many resources, that would, under a good administration—which up to the present time it has never had—be sure in a short time to develop themselves, and amply repay Roumania for the exchange of Bessarabia to Russia.

THE WIRE BOOK-SEWING MACHINE.*

The most important step forward that has lately been made in bookbinding is, undoubtedly, the substitution of wire for thread. A machine for sewing books with wire was recently exhibited at a meeting of the Franklin Institute, where several books were sewed before the audience.

The principle of this machine consists in producing a number of U-shaped wire staples, which are driven from the inside of each section of the book through the back, and through one wide or several narrow bands of a strong linen or cotton fabric, whereupon the ends projecting through the back are clenched over, and thus a firm connection between the sheets of the section themselves and the band, or bands, covering the back of the book, is produced. The machine fastens a section at each revolution of the main-shaft, and can be run at 40 to 43 revolutions per minute. The book sections are fed by the operator, partly opened, upon a table, which, by an oscillating motion, brings the sheet in position to be sewed. By an adjustable downward feed of the table on which the book is sewed, the section can be sewed tight or loose, to suit the degree of "backing" in the subsequent forwarding of the book. The principal merits of this mode of binding books are, strength, durability, and flexibility, besides the saving of labour, as an operator can turn out as much work on one of these machines as from five to eight operators can do by hand. Greater strength is given by the several sheets of each section being clamped firmly between the back and the clenched legs of the wire staple, while the thread in thread-sewed books holds the centre sheet only by the edges of the cuts through which the thread passes. If the inner sheet of any section of a thread-

* A paper, by H. Bilgram, read before the Franklin Institute, Philadelphia, October 15th, 1879.

bound book be torn out by force, the thread cuts its way through the fold of the sheet, while in a wire-sewed book the sheet will tear in a double line, leaving a small strip of paper underneath the wire staple. This simple test proves at once the superior strength of a wire-sewed book.

The firmness of a wire-sewed book is not so much dependent on the glueing of the back as is the case with a thread-bound book. The inner sheet of any thread-bound book is held in position by the glue in the several saw-cuts; for, if this connection is carefully severed without injuring the thread connection, the sheet can be moved up and down as much as the thirty-second of an inch, while nothing short of actual tearing of the paper can make the corresponding sheet of a wire-sewed book move through the same distance. Rusting of the iron wire is effectually guarded against by tinning it. Increased flexibility is insured by the diminished thickness of the flexible back of the book. In the old way of binding, the flexible connection of the several sections of the book is represented by two or more comparatively thick strands laid in the saw-cuts on the back of the book, and held there by the threads passing round them; while on the wire-sewed books the corresponding connection extends over the greater part of the back, and is not only much thinner and more flexible, but also much stronger. The book opens very freely indeed.

In binding the first books sewed with wire, some difficulty was experienced in the wires thickening the back of the book so much that, in pressing it for the purpose of cutting, the paper was crushed by the wire just where it should have been strongest. This defect has been overcome by inserting the staples in a zigzag line, so that there appear two or three times as many rows of staples on the back, as there are staples in each section.

CORRESPONDENCE.

ARMENIAN LIBRARY, SMYRNA.

In consequence of late events in Asia Minor, the study of the English language has been taken up with more vigour, and an appeal for the contribution of English books is made on behalf of the Armenian Reading-room and Library, in Smyrna, established in 1869. Books, journals, and newspapers, may be sent to Captain Stab, Corresponding Member of the Society of Arts, Smyrna, or to Mr. H. Papa Sian, Smyrna. The postage is cheap, as Smyrna is within the Postal Union. I beg strongly to urge this application, as the members of the library have already 2,000 volumes, many of which are English. Hyde Clarke.

32, St. George's-square, S.W.

DOMESTIC POISONS.

In the *Journal of the Society of Arts* for the 23rd Jan., and in the latter part of the paper on "Our Domestic Poisons," by Mr. Carr, we find a paragraph on tapestry carpeting (vol. 28, p. 157).

No one acquainted with carpet manufacture could be misled by the observations contained in the paragraph; but, for obvious reasons, we are compelled to notice the same, and, for the information of those not so familiar, we feel called upon to give the following facts:—

It is perfectly true that the so-called stuffer or material used to give substance to the tapestry carpet fabric is sized, but the size used for the purpose by the chief makers is perfectly inodorous, being entirely flour.

It is absolutely incorrect that size is required or used to keep the wool surface in place.

Except by great care in preparing the size necessarily used in the manufacture of all carpeting wherein linen weft is used, unpleasant smell will temporarily pervade a carpet when first laid down. This statement is based upon an experience of over 40 years, and before tapestry carpeting was manufactured to any extent, if at all.

There is nothing different in the manufacture of Brussels and tapestry carpeting that one should be more liable to smell than the other; either is liable to smell in the absence of the most scrupulous care and attention in their manufacture.

The manufacture of tapestry carpeting dates from 30 to 40 years back, and has been steadily progressive, which would not have been the case had the statement referred to been correct.

We trust you will give the same publicity to this letter as you have given to the paragraph alluded to.

Edward Crossley & Sons.

Dean Clough Mills, Halifax,
February 27th, 1880.

GENERAL NOTES.

Population of the Globe.—The population of the globe has been roughly calculated at 1,421,000,000, giving the following numbers for the chief divisions:—Europe, 309,000,000; Asia, 824,000,000: Africa, 199,000,000; Oceania, 4,000,000; America, 85,000,000. The annual number of deaths throughout the world is put at 35,693,350, or 97,790 persons each day. The balance of population is, however, more than kept up by births at the rate of 104,800 per day.

The French Wine Trade.—It appears that the value of wines exported from France is annually decreasing, while that of wines imported into the country is increasing. The following figures given in the *Times* represent the value of the imports and exports during the past ten years:—

	Value of Imports.	Value of Exports.
1869	£565,640	£10,441,520
1870	196,160	8,921,200
1871	267,120	9,402,560
1872	775,080	10,939,800
1873	1,150,720	11,250,000
1874	1,189,840	9,170,320
1875	551,800	9,899,240
1876	1,010,680	8,464,120
1877	1,178,560	8,430,440
1878	2,509,920	8,320,040

The balance of trade has turned against France to the value of about £4,000,000 in ten years. The imported wines have been chiefly from Spain, but a large quantity are Italian wines. This serious diminution in the viticultural produce of France has been chiefly owing to the ravages of phylloxera.

MEETINGS OF THE SOCIETY

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

March 10.—"Recent Advances in the Production of Lambeth Art Pottery." By John Sparkes. Sir Philip Cunliffe Owen, C.B., K.C.M.G., will preside.

March 17.—"The Art of the Silversmith." By W. Herbert Singer. A. J. Mundella, M.P., will preside.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

April 14.—"The History of the Art of Book-binding." By Henry B. Wheatley, F.S.A.

APRIL 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. HOLMAN HUNT.

APRIL 28.—"Recent Improvements in Gas Furnaces for Domestic and Lavatory Purposes." By THOMAS FLETCHER.

MAY 5.—"On the last Forty Years of Agricultural Experience." By JOHN C. MORTON.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"The Present Condition and Prospects of Agriculture in South India." By W. ROBERTSON, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

MARCH 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. FOOT, R.N.

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

MAY 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. JAMES SIBREE, jun., F.R.G.S.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MARCH 11.—"Balmain's Luminous Paint." By C. W. HEATON, F.C S. Professor H. E. ROSCOE, F.R.S., will preside.

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13—"On some Physical Applications of Light." By Prof. W. G. ADAMS, F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock:—

The Second Course, "On the Manufacture of India-rubber and Gutta-percha," by THOMAS BOLAS, F.C.S.

LECTURE VI.—MARCH 8.

Gutta-percha. Sources. Chemical nature and physical properties. Purification. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 8TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Thomas Bolas, "The Manufacture of India-Rubber and Gutta-Percha." (Lecture VI.)
London and Middlesex Archæological, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. F. J. Hilton Price, "Notes on Excavations at Temple-bar." 2. Rev. R. Hawley Cluttebuck, "A Londoner's Trip to a Country Cousin's in 1773."
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Lieut. G. T. Temple, "An Autumn and Winter Yacht Voyage along the Coasts of Norway and Lapland."
British Architects, 9, Conduit-street, W., 8 p.m. Special General Meeting.
Medical, 11, Chandos-street, W., 8½ p.m. Annual Meeting.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. F. J. Palmer, "Life-saving Apparatus."

TUESDAY, MARCH 9TH...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture IX.)
Metropolitan Scientific Association, 13, Blomfield-street, E.C., 7 p.m.
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. H. E. Jones, "The Purification of Gas."
Photographic, 5A, Pall-mall East, S.W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. Francis Galton, "Visualised Numerals, and other Forms of Mental Imagery." 2. Mr. C. H. E. Carmichael, "Notes on Prehistoric Discoveries in Central Russia."
Royal Horticultural, South Kensington, S.W., 1 p.m.
Folk Lore, 22, Albemarle-street, 8 p.m. 1. Mr. J. S. Udal, "Dorsetshire Mummery Plays." 2. Mr. Alfred Nutt, "Critical Notes on Celtic Folk-tales and Heldensage."

WEDNESDAY, MARCH 10TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. John Sparkes, "Recent Advances in the Production of Lambeth Art Pottery."
Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Croonian Lectures.) Dr. Cayley, "Some Points in the Pathology and Treatment of Typhoid Fever." (Lecture III.)
Geological, Burlington-house, W., 8 p.m. 1. Prof. E. Hull, "The Rocks of the South of Ireland and North Devon." 2. Mr. G. R. Vine, "A Review of the Family Diastoporidæ for the Purpose of Classification." 3. Mr. W. H. Twelvetrees, "A New Theriodont Reptile (*Cleiorhizodon orenburgensis*, Twelvetr.), from the Upper Permian Cupriferous Sandstones of Kargalinsk, near Orenburg, in South-Eastern Russia."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m.
Royal Literary Fund, 10, John-st., Adelphi, W.C., 3 p.m. Annual Meeting.
Telegraph Engineers, 25, Great George-street, Westminster S.W., 8 p.m. Mr. Alexander Siemens, "Some Recent Improvements in Electric Light Apparatus."

THURSDAY, MARCH 11TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Applied Chemistry and Physics Section.) Prof. C. W. Heaton, "Balmain's Luminous Paint"
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. W. H. Monk, "Some Predecessors of Bach and Handel."
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Miss Edith Heraud, "Tennyson."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture VII.)
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, MARCH 12TH...Royal United Service Inst., Whitehall-yard, 3 p.m. Rear-Admiral C. Murray Aynesley, "The Preservation of Boilers."
Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Dr. C. W. Siemens, "The Dynamic Electric Current and Some of its Applications."
Astronomical, Burlington-house, W., 8 p.m.
Royal College of Physicians. (Lumleian Lectures.) Dr. W. Roberts, "Researches on the Digestive Ferments and the Preparation and Use of Artificially Digested Food." (Lecture I.)
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
New Shakespeare, University College, W.C., 8 p.m. Paper by Mr. T. Alfred Spalding.

SATURDAY, MARCH 13TH...Trades Guild of Learning (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Lecture by Prof. Hales.
Physical Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. George Saintsbury, "Dryden and his Period." (Lecture III.)

ERRATA.—Page 280, line 33, *for* "boys should be trained," *read* "bogs should be drained." Line 46, *for* 20, *read* 200.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,425. VOL. XXVIII.

FRIDAY, MARCH 12, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

UNION OF INSTITUTIONS.

The following Institutions have been received into Union since the last announcement:—

Church of Scotland Training College, Glasgow.
Working Men's Institute, St. John's, Blackheath, S.E.

CANTOR LECTURES.

The sixth and concluding lecture of the Second Course of Cantor Lectures, "On the Manufacture of India-rubber and Gutta-percha," was delivered by THOMAS BOLAS, F.C.S., on Monday, 8th inst., the lecture being specially devoted to the treatment of gutta-percha. The Lectures will be printed in the *Journal* during the summer recess.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1880, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to M. Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

The Council invite members of the Society to forward to the Secretary, on or before the 24th of April, the names of such men of high distinction as they may think worthy of this honour.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 10th, 1880; Sir Philip Cunliffe Owen, C.B., K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Brittain, Henry, 200, George-street West, Birmingham.
Gardner-Bain, Andrew John, Blairnairn, Helensburgh, N.B.
Horner, Edward, May-place, Crayford.
Rolls, George, 34, Camberwell-green, S.E.
Scott, William Thomas, 57, Canonbury-park North, N.
Taylor, George W., 116, Cannon-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Bakewell, Herbert James, 60, South Hill-park, Hampstead, N.W.
Clarke, Frederick N., 3, Bolt-court, Fleet-street, E.C.
Collins, C. R., Hele, Cullompton, Devon.
Dunn, John, 53, Brown-street, Manchester.
Gamble, Josias Christopher, St. Helen's, Lancashire.
Hodgson, John S., Hexham.
Somerville, William, Belvoir-street, Leicester.

The paper read was—

ON THE FURTHER DEVELOPMENT OF THE FINE-ART SECTION OF THE LAMBETH POTTERY.

By John Sparkes.

In May, 1874, I had the honour to read a paper in this place on the new methods that had recently been introduced into the Lambeth Pottery. I now propose to carry on the history of what has proved no inconsiderable development of the beginning recorded in that paper.

I fear a recapitulation of some parts of the former paper will be necessary, to put the present audience in possession of such facts as may enable them to form an opinion of the subject, and rightly to estimate the difficulties that have been overcome. I must, therefore, ask the indulgence of those of my hearers who are acquainted with the former paper, while I describe, in as few words as possible, what the Lambeth ware is.

The Lambeth potteries have produced stoneware since the middle of the 17th century. Stoneware is an impervious material, very dense, all through alike, of sufficiently close texture to resist the action of acids and chemicals generally, fired at an intense heat, and glazed with salt. This character is peculiar, and is shared with no other pottery ware whatever.

It is well known, in the case of ordinary earthenware, china, faïence, delft, and so on, that the body of the ware is first made and fired, and that, by a later and a second operation, the glaze is applied, by dipping the piece to be so decorated in the fluid of the glaze-tub; this, after a second firing, fuses, and covers the piece of pottery with the shining covering of glass we call glaze. In stoneware, no second operation of this kind is necessary, for a single firing converts the dry clay into a glazed piece of pottery. In this peculiarity lies the interest and the difficulty of decorating stoneware. Everything—from the throwing of the vessel during its decoration to the colouring—must be done before the piece is fired, and while it is still in the clay stage.

The heat required for stoneware is much in excess of that usual, or even necessary, for the ordinary earthenware, and is, perhaps, not exceeded by that of china kilns.

These necessities of the manufacture were, originally, a source of trouble, since the ordinary colours were too fusible, and commonly evaporated in the kilns in the first trials, and those that would resist the intense heat could not withstand the long-continued "soaking"—as the potters call it—of the stoneware kilns, which are of large size, and, consequently, contain a large mass of heated material, difficult to cool quickly without the risk of loss from the suddenness of the process.

The salt glaze was the source of another class of difficulties. It acts somewhat in this way. When a kiln full of ware at white heat is "salted," by salt being thrown into it, either from the top of the kiln or into the fire-holes, or by both methods, the salt is decomposed, and becomes a vapour, in which soda and chlorine are constituents; the soda combines with the flint of the ware, and fuses a portion of its surface into pure soda glass; the chlorine and steam which escape from the kiln into the air form those white fumes so well known in Lambeth, and said to be endowed with the most irritating and rodent qualities by those who do not know their real nature, and the insignificant amount of the salt thus volatilised.

This is a fine-art paper; therefore, I ought not to remark that the so-called noxious vapours of the kilns are those which, in the opinion of many, are the means of keeping the alleys and slums of the neighbourhood of the potteries free from contagious disorders, by killing the germs of many diseases which, in other less favoured districts, have their full swing, to the harm of the inhabitants; they form a sort of wholesale disinfectant, which the potters, in innocent unconsciousness of their good deeds, give to the district freely, once a week at least.

This gaseous glaze is perfect, inasmuch as it is pure glass; very hard, very thin, and so perfectly applied that there is no thickening and running into uneven surfaces and masses, as is seen in other methods of glazing, more or less; but it is uncertain in another way, for, strange as it seems to the eye, which perceives, on looking into a kiln, nothing but a mass of ware glowing at white heat, there are cool corners in the kiln, and quiet places where the vapour scarcely penetrates, or corners of such fierce draught that the ware scorches the salt glaze to mere brownness. Thus, the risks are more numerous than those which beset the earthenware potter, who deals with dipped glazes only. So, again, the colours are variously qualified by the descent of the salt into the ware, and by the uneven evaporation of the material. Then, again, all the ware at Lambeth is burnt without the use of "seggars;" it is fully exposed to the open fire, and not protected in any way. A seggar is a fire-clay box, or set of boxes, like a number of pill boxes of large size, in which a few or separate pieces of ware are placed; the object of these boxes being to protect the ware from the direct action of the fire, it follows that many of the troubles that have beset the Lambeth ware are avoided by this method.

In 1874, there were seven methods of decoration, which could be summarised thus :—

1. Scratching or cutting the pattern in the clay very soon after it leaves the thrower's wheel. A line scratched at this time leaves a ridge on each edge of the tool, and this "burr" limits the colour applied to the pattern by its mechanical projection.

2. Cutting into the clay some hours after the piece has been thrown, when it is in the state called "green hard." At this time there is no burr, which breaks off if it is raised; therefore, a line is more scooped out than cut in. It serves, to some extent, as a limiting agent to some colours, but more frequently it gives a hold to the pigment, and deepens its colour by its greater depth of substance.

3. Whitening the body.

4. Dipping the ordinary body, which is like the usual brown stoneware, in a slip of lighter colour, which gives the opportunity of cutting through the lighter surface, so as to expose the deeper tone of the body below.

5. Carving out mouldings, by cutting into ridges or projections left for the purpose by the thrower, a method by which a certain amount of light and shade may be introduced into the ware.

6. The application of dots, discs, rosettes, and innumerable other figures from moulds, impressed on the surface of the ware, so as to adhere to it.

7. Similarly, depressed patterns are stamped into the surface of the clay, to form a hollow for the lodgment of the colour as it oozes in the intense heat.

These distinct headings described all the methods of treating the ware up to the date of the previous paper in 1874.

The state of the manufacture was, perhaps, more remarkable for the freedom from disaster than for the uniform success that now may be said to characterise the productions of the kilns. Various improvements in detail, especially in the setting of the ware in the kilns, a better experience in the firing, gained by the practice of burning for Doulton ware, which formerly took its chance among the miscellaneous contents of the kilns, tend to this higher per-centage of success; but, in the details of the decoration, and, to some extent, of the manufacture, great advance has been made. The intention I have in writing this paper is to bring some of these newer forms under your notice, and to record, as was done in the former paper, the names and marks of the artists who have worked so well to develop the ware to the state of beauty you now see it has arrived at. Various new bodies have been found, which work remarkably well under the trying conditions of the salt-glaze kiln, and give change of texture and variety of surface; various materials and colours have been found, which work well as decoration on these bodies; and additional artists, nearly all students of the Lambeth school, who bring their peculiar and individual tastes to bear in the working out of these new materials, and in the experiments in original methods and in other directions, help, by ideas and skilled handicraft, to forward the good work.

I wish, first, to speak of the new bodies; then of the new materials for their decoration; and, lastly, of the new applications of both, and the artists who work them out.

The whole question of coloured bodies—or of bodies different from the ordinary common or fire-clay body—is a large one, and one that has an almost illimitable bearing on the future of stoneware. In ancient times, there were three kinds of bodies that were very distinct; a white made at Siegburg, the ordinary grey, and the brown made at Rohren. The latter was, probably, a local production, or may have been burned with coal. The white of Siegburg was sought after as a precious thing, and was, accordingly, produced with care, and sold at a high price, when the potters succeeded in preserving the dead white that characterises the best pieces of this manufacture. We must not forget that the old manufacture existed in a comparatively small district of the Rhine, and did not extend its roots laterally from that river more than a few miles; further, that the trade was a good one, and that the "silent highway" carried the ware to Holland, and all parts that traded with that country. So that there was probably little spur to exertion on the part of the potters of the 16th century to find new bodies or improve their old ones. The same may be said of their colours; they had but two, cobalt and manganese, and do not seem to have been tempted to enlarge their experience or their range of trouble by experiments that would give them a wider range of effects.

At Lambeth, however, we have had a more stimulating atmosphere to work in, and many bodies have been proved. Some of these are shown to-night; others are kept in reserve until the demand shall be made for such things, and then they will be introduced to the market. You will see, among the specimens here, that we have bronze, green, brown, black, blue, chocolate, grey; all the above lightened; and white. All these are arranged to bear the vigorous experience of the salt-glaze kiln, and, naturally, can be fixed as a dry body as well. Several applications are on the table to-night, sufficient to show the great variety of colours at the disposal of the Lambeth artists.

In the search for new decorating materials, some excellent combinations were lighted on, which have been used in the construction of vessels of which the body is of these compounds. I instance these so-called jasper bodies. The term is the same as Wedgwood's name for this kind of material, which is of a dry, unabsorbent texture, and does not take any marks from dust or from soiled hands; nor has it any of the many disadvantages attending on the use of a dry body. It takes various kinds of decoration; for instance, ornament may be stamped into it, or applied upon it; any colour, or colour with a glaze, may be added. I have examples here of this ware in red, brown, grey, blue, green, and buff, and the different kinds of decoration I have enumerated above are seen on them.

The dryness of texture is the peculiarity of this new body, and, so far, it is not properly Doulton ware, inasmuch as it is not subjected to the salt glaze of the stoneware kilns. The same material in the salt-glaze kilns produces the subdued glaze called by potters a "smear," a very delicate, waxy, or ivory-like texture. This, too, may be heightened with colour. A sort of side development of this detail is seen in certain self-coloured vases, fired in the salt-glaze kilns; the polish and

velvety richness of surface is brought to perfection under the strong fire, and the mottled surface due to the salt and other causes give a sort of texture as delightful to the eye as Oriental alabaster.

All these bodies, whether jasper or glazed, are easily decorated by the application to the surface of the ware of medallions or discs from a seal or mould. Several of these are shown where the medallion is an adaptation from the antique, especially from Greek coins or brasses, which appear eminently suited for cautious use in this way.

Especially I call attention to a bronze body, which is so like metal as to be deceptive. No doubt, this and some other materials will have a decorative value in the future at present but little foreseen. This one in particular is as well suited as bronze itself for the exhibition of form, as distinct from surface decoration.

A system of decoration which has already been alluded to—namely, the setting on of small parts of a pattern by placing a repetition of a unit, side by side close together, so as to form, when complete, a whole pattern—is used in the jasper ware and other coloured bodies. Many interesting and beautiful combinations of greys, browns, &c., with pleasant repeating ornaments, are results of this method of working.

Somewhat related to this system of ornament is that by which coloured clays are applied in strips to the soft ware, and worked into the design, which is only developed in the kiln; and akin to this is the method by which the ware in a clay state is dipped in slips of different colours.

A "slip" is a clay, natural or coloured, which is diluted with water until it is fluid enough to run in creamy thickness. It is obvious that a body dipped into such a mixture will become coated with it to a certain thickness, which depends on the amount of water in the solution, also on the amount of the absorption in the body that is dipped. At any rate, a certain amount is deposited as a film or veneer of clay that can be scraped through, as lines to show the colour of the body underneath as the outline; or it can be removed in larger surfaces to form the broader masses of the pattern, or even the whole of the background may be scraped away. (See Fig 1.)

This method is seen in the examples of which these are good specimens.

The introduction of colour, in the infinite combinations that these varied bodies are capable of forming, is a source of ornament that requires only to be governed by good taste to be always new and a delight for ever.

This question of decoration by the application of one coloured clay on another is, perhaps, the most legitimate work the potter can undertake. There is a certain harmony in the colours of the clays which underlies the artificial tints that may be given to them, and these are, in the hands of an able designer, capable of being made exquisite in their tender contrasts (not that it is impossible, or even difficult, to obtain such juxtaposition of tints as to make a discord of tones or colours that is sometimes very offensive), and, in the early history of the ware, we sought to obtain the blue-grey ground of the old Rhenish work, feeling that it was a natural harmony in colour with the cobalt with which it is decorated. And some serious

Fig 1.



thoughts were entertained respecting the re-introduction of wood as a fuel for the fine-art kilns, in order to keep the grey of the natural clay, and to avoid the blackening and soiling of many colours by the action of the sulphur and other products of the burning coal to which the ware is exposed; but we had to come face to face with the difficulties, and I think it may be claimed that, whatever the difficulties were, they have been overcome.

I mention this desire of years gone by, to keep the natural grey of the clay to heighten the cobalt, to show how entirely the production of good decoration is a question of good taste; for the German potters, in the old districts of Grenzhausen and Höhr, have revived the old manufacture, and are filling our shops with those strange and uninteresting forms of which you see some specimens here, constructed out of the grey clay, and coloured with the cobalt as of old—and so far under precisely the same conditions as the old patterns worked—yet you will observe the wretched poverty and positive unpleasantness of the colour. These pots are, nevertheless, regarded with great favour in the Fatherland, as they are to be met with in every town in Germany; and if I said in every town in England, too, I should not be far from the truth.

It is interesting to know that our difficulties in this matter are so successfully overcome as to have been the object of remark by some German gentlemen connected with the Berlin Art Museum, who wished to get the brown Lambeth clay, as, in their opinion, the blue developed so much better on it than on their natural grey. Thus, I say that the

application of colour, under the best circumstances, is a matter of taste.

Another method appears to me to be fruitful in results of a very charming kind; it is shown in this example. You will see that the borders or margins of the patterns are raised, looking as if they were modelled; these margins are then scalloped, or pressed, or modelled upon to produce every kind of contrasting edge necessary to look well against the smooth body of the pot itself. These raised edges are formed out of strips of clay laid on the vessel, while it is still soft enough to make the adhesion complete; they are then pressed and coaxed into the various forms you see. This plan adds interest, from the variety of the light and shade it gives, and from the colour of these raised portions, which, obviously, can be applied with clay that has a natural or artificial colour. The difficulty of the proper adhesion, and the amount of projection it will bear safely, are matters of experience now pretty well known to the artists, or quite well understood by the firemen of the ware; at any rate, it is done with great certainty, and we do not anticipate any new difficulties in this direction.

By far the most important introduction has been a method of decoration, to describe which a French term has been used. It is called "pâte sur pâte." It is, perhaps, more correctly so-named than the French ware which bears the same designation. The term "pâte" in French has been translated literally as paste, and hence the rather unmeaning description of china as hard and soft paste of some writers; but "pâte" means body, and "pâte sur pâte" describes that method of decorating one body with another of a different tint.

This very beautiful material was produced to show at the Paris Exhibition of 1878, and has been worked since with great success. To paint with the earthy pigment requires great decision of hand and accuracy; and, as each touch with the brush delivers the exact amount needed for the leaflet or digitation of the foliage used, it requires much practice and unerring certainty in planting the material on the ware firmly and in the right place.

The peculiarity of the method has produced a certain conventionality in the decoration, and a crisp-leaved sort of parsley-fern pattern seems to be the one mostly adopted. You will see examples here of two kinds, at least; one with the small patterns arranged somewhat as an Italian ornament, but with its peculiar and fine details (see Fig. 2), and another broader, larger treatment, both are the product of different artists' taste, and may serve to show how much is gained by allowing the individuality of the designer to have full swing.

There are eighteen colours and tints which can now be used in these ways—giving a possibility of infinite variety and endless combinations of colour and form.

The difficulties here overcome were great and numerous, but a very accurate adjustment of flux and pigment has been worked out, so that the opaque portions partly burn away, and become semi-transparent, showing the ground through; one great trouble was to obtain adhesion between the body and the colour; this, however, is now successfully overcome, and I ask your attention to these beautiful examples of stoneware burned in the open kiln and glazed with salt. This is absolutely new in the potter's art, and is a true example of the "pâte sur pâte" principle, inasmuch as it

FIG. 2.



is not enamel, but body, that is the basis of the decorating material.

Another very beautiful source of decoration is due to the manipulation of the clay, while still plastic, in the recently thrown form. Saucers, dishes, and plates, with their edges, may be, as you see here, completely turned over as to their margins; others have their rims only partially turned, so as to form a shell-like cavity and handle; others are completely fluted and frilled at their edges. (See Fig. 3.)

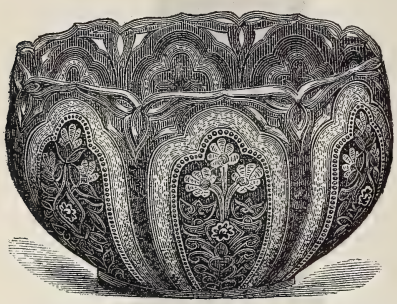
FIG. 3.



This principle is a very beautiful one, and one that lends itself to the taste of the designer in a variety of ways; for not only can the edges of the ware be thus treated, but also the vessel itself, and I now show you a series of objects—bowls, pitchers, vases, &c.; and, indeed, any pot can be so treated—in which the depressions and the bumps are produced entirely in the clays while soft. This goes, as you observe, to the extent of shaping the object afresh; for example, out of a circular bowl, as thrown on the wheel, we have a square one, or a polygonal one, or an elliptical one, or a shape combining all these forms. (See Fig. 4.) On these shapes, again, we have depressed grooves in rings, or in upright series, or in spiral windings, and these, crossed by others, giving a most pleasant variety of surface and of light and shade; and, again, no two can possibly be alike, and all are

the immediate product of the artist's mind. No mechanical process comes between him and his plans; he presses as far and as deeply as he wishes,

Fig 4.



and then treats these grooves to an ornament that will be appropriate to them. (See Fig. 5.)

The two artists who have done most to work out this beautiful decoration are two that I have men-

Fig 5.



tioned, and whose marks are given in the previous paper, George Tinworth and Frank Butler.

A beautiful method of decorating some of the above-mentioned squeezed or hand-moulded pots is by placing a ribbon, or inlay of pierced work, over the depression, so that the appearance is given of a perforated band of ornament in front of a rich background of shadow. There are many instances of this perforation in Eastern porcelain, and in our own English manufactures; but none in stone-ware, so far as I know. The effect is always interesting and rich, and has a certain mystery of light and shadow, but the difficulties in applying it to stoneware were very great, and even now the absolute certainty of success is not so assured as to lead us to hope it will be a very general method of decoration; still, there have been excellent examples, of which I show some here.

It is, perhaps, right to say that the designs and models for some of these perforations were made by an artist whose name and signature I gave in the former paper, Arthur Barlow; but who is, I regret to say, no longer in this world; he died a little more than a year ago. Many of these beautiful discs are the labour of his last months of weariness, when he was too ill to leave his room; but they give no evidence of any falling off in the spirit of the artist.

In a certain relationship with this application of perforated discs is the similar use of solid discs, on which may be modelled any appropriate pattern; such as a head, or an ornament. This may be a simple relief, or it may be an *appliqué*, in coloured clays, and might be called medallion ware, as, to the present time, the idea of using it for the reception of models after antique heads has been the prevalent one.

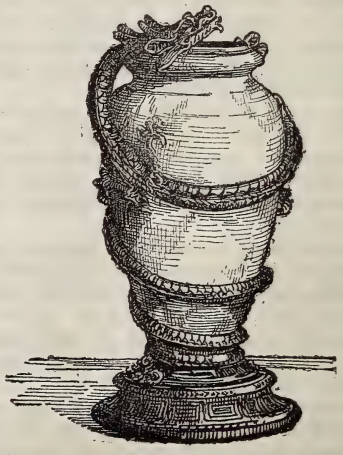
The system of moulding a modelled piece of ware, which is the commonly used one in all potteries with which I am acquainted, is discouraged at Lambeth as much as possible, as tending to mere mechanical reproduction, and as leading to a lifeless kind of repetition.

It is, nevertheless, used sparingly, as in the instance of this pot, decorated with seaweed. Here the body is thrown, and the separate leaves of the modelled seaweed are taken from a mould and pressed on—"thumbed" is the potter's name for it. You will perceive that the leaf is made to adhere here and there, not evenly all over, and that it has a sharpness and crispness not attainable out of the ordinary mould, which always wears at the edges, and soon gives a thickened, gummy-looking impression.

In the case, also, of some kinds of bottles of octagonal shape, not possible to press by hand, it is used; but, in this latter case, the ornament is added by hand, or carved on the moulded form by hand. With these exceptions, every piece is the product of the eye and trained hand of the thrower.

A section that has always appeared to me to be most valuable, and one to be encouraged by all means in our power, is this, where the designer

Fig. 6.



models on the piece that the thrower makes. The examples here of this work are unique in their way. The artist (Mr. Cund) has, as you will see, an

absolute gift for perceiving the devilries in the Japanese and Chinese dragons. These beasts form his favourite subject, and he manages to introduce a spirit of fiendish energy into their expressions, their lean reptile proportions and destructive claws, that is to my mind entirely remarkable. On the same plan as these, various picturesque, yet ornamental, treatments of birds, beasts, and other natural motives have been attempted. It is hardly necessary to do more than dwell for a moment on the demand this treatment makes for originality, and we may say distinctly that no two vases can be designed on the same lines; that to vary pots of the same form is easier than to copy slavishly, and all temptation is thus removed from the artist to repeat himself.

There are a few other examples of this plan of modelling on the ware itself which will prove the position I take, viz., that it is a stimulus to individuality, and comes as a change from the etching or cutting-in of a pattern, in which some ladies—notably, Miss Barlow—excels; she occasionally feels that she can best express her intentions by a modelled figure of an animal in low relief, and is, of course, quite free to do this, or adopt any other method she chooses.

Finally, in the list of new applications and processes which I have given an account of, comes a development in the direction of wall-decoration, as a kind of mosaic, formed of small pieces of mechanically fitting stoneware, keyed together with bosses or buttons of colour. The effect of this material in panels is remarkably bright and rich, and, as it is in relief, it gives just that amount of interest to the centre of a panel that we naturally look for. It is, of course, practically indestructible, and answers to the conditions that some utilitarian moderns require in decoration—that it can be cleaned with a fire-engine.

I conclude this section of the subject by calling your attention to the great variety of grounds, or diaper treatment of backgrounds, seen in the vessels and ware on the table. These are grounds impressed with a die, cut into the form of a unit of the diaper, which is developed over the surface by being stamped into the clay side by side in repetition. This, in some cases, is combined with an under treatment of the surface; so that it appears on a background itself, mostly of single scratched lines, and sometimes of wavy lines.

Then this may be further used as the basis on which a film of colour is spread, which runs into the small scratches and the impression the stamp has made, and makes the diaper evident by its darkness where the colour is thickened in the lines.

Again, you will see background diapers prepared by painting with the "pâte sur pâte" material, either with a rich Roman ochre colour on the ordinary clay, or with white on the Roman ochre body, and frequently a combination of each method, which, in some cases, alternates in small squares, set side by side or diagonally.

Perhaps the best illustration of the various treatments of these surfaces is given in certain pots that are ecclesiastical; they were designed, as to their forms and symbolism, by Dr. Lee, for church use, and are carried out in a manner that is very expressive of the good taste that governs the studios where they are produced. (See Fig. 7.)

Fig. 7.



As to the artists who have worked so zealously to forward this great artistic manufacture, I can name certain of them who excel their neighbours, by reason of their greater opportunities and longer practice.

Those whose monograms I gave in the last paper remain, with two exceptions, and continue to produce, with untiring energy, new designs, and new application of old ones, in a marvellous way.

George Tinworth, whose name is widely known as a modeller of religious art that is quite unique of its kind, has lately executed a relief for the reredos for York Minster, and some excellent reliefs for the Guards' Chapel in St. James's-park, and quite realises the favourable prognostic I ventured to make for him when I last spoke on the subject here. He has added numerous conceits in the way of handles, ornaments, and small objects, many of which you see before you.

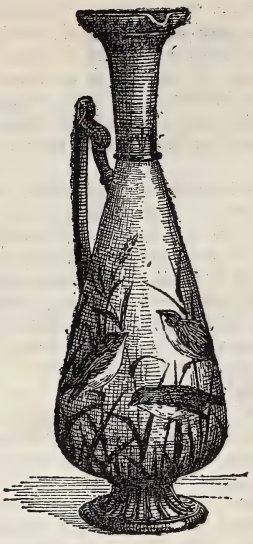
Frank A. Butler has developed into a master mind in his handicraft. He not only produces designs for himself, but keeps three or four assistants busy by designing forms and patterns for them to carry out. His best work, perhaps, is that where the ground is carved, leaving the pattern in relief, and he is *facile princeps* in the treatment of the wet clay vessel, by squeezing it into shapes such as I have mentioned and shown you.*

Miss Hannah Barlow also continues to give those clever and beautiful etchings of animals, which have such a concentrated spirit of observation in them as to seem inspirations from the very nature of the beast she is depicting. She has occasionally added rustic figures to the flocks and herds, with more or less success.

Her sister, Miss Florence Barlow, covers a more extended field, as she takes both ornaments and animals, and has recently executed some very charming paintings in coloured clays—of birds especially, which give a conventional light and shape and colour treatment to her desires, very helpful on the score of variety. (See Fig. 8.) Two large vases I now show you are by this lady, and are, I think, two of the finest that have been produced.

* Figures 4, and 5 are from vessels he has decorated.

Fig. 8.



The other two artists whom I mentioned in the previous paper, Mr. Arthur Barlow and Miss Emily J. Edwards, have passed away from our circle of Lambeth artists, but it is a consolation to us to remember that they were happy in their work while here, and have added to the whole sum of pleasure in the world by the objects of beauty they have invented, and which will last for ever to testify to their artistic skill and love for their work. Their deaths left a gap in our studios that no one has filled.

I now wish to add a few names and monograms to those previously given.

First among those who have thrown their whole energy into their work is Miss Eliza Simmance. Her work is not only designing with the stylus, but, especially she excels in painting the "pâte sur pâte" patterns. There are examples of her work here which are so eminently graceful and well-drawn as to emulate the same qualities in the work of the Italian ornamentists. She, too, has so many ideas to spare—more than she can work out by herself—that she keeps a staff of rising artists occupied in carrying out her instructions. (See Fig. 9.) This example of her work is partly painted, partly incised, and the main body of the ornament is carved out of the solid clay. (See also Fig. 2 for another piece of her work.)

Another lady, Mrs. Eliza S. Banks, has taken up the painting on stoneware by the "pâte sur pâte" method, and has invented and executed some excellent designs on a larger and more picturesquely ornamental scale than anyone else. Her work is recognisable by a certain freedom of brush work, which, perhaps, occasionally verges on the natural side of the line that is conventionally held to divide nature from ornament.

Then, Miss Louisa E. Edwards may be taken as representing a style of decoration taken remotely from the Indian and Persian conventional flowers, but drawn with clear lines of perfect construction, and distributed with judicious thought, taste, and skill. (Fig. 9 is a drawing from one of her designs;

Fig. 9.



Fig. 10.



it is incised on a grey ground, with dark blue flowers.) Associated, to a certain extent, with her is Miss Louisa J. Davis, who has had considerable influence in a certain direction in enlarging the plan of treatment of the same Persian or Indian motives in their stoneware translation, and has treated certain natural plants—notably, reeds, sedges, and grasses—with a masculine vigour and power of drawing that remind one of old Gerard's woodcuts.

Also, Miss Edith D. Lupton has worked out some very characteristic half-natural forms, that in their distribution and grace leave nothing to be wished.

Miss Frances E. Lee has taken almost all sections under her care, and it is a little difficult to say in what she especially excels. She has taken up the method of pressing form into the wet clay, and has hit upon some fortunate combinations of this with surface ornament. Some of her simply incised surface decorations, also, are very good in their flatness.

Miss Mary Mitchell has lately begun to add outline incisions of rustic figures, treated with a pleasant semi-classical simplicity that promises well in the future.

Two other artists, also, should be named, Mr. John Broad and Mr. Beere; they model well, and several of the works of art here shown are by them.

I instance the centre-piece of Mr. Beere's design, and call attention to the simple and classical feeling in the figures which support and surmount it.

The pilgrim bottle, with the head of Lysimachus, is the production of Mr. Broad. It is obvious that modellers of figures must submit to the moulding of their productions, as a human figure cannot be supplied with the readiness with which a purely ornamental form can be modelled. Hence these forms are repeated occasionally.

There are several others who are not at present quite yet so developed as to demand especial notice; but who, if in another six years I should be asked to record the further advance in Lambeth ware, will have made their names known in connection with the new art manufacture.

Thus, so far as relates to the stoneware manufacture, I have given a short epitome of the new lines that have been entered on during the last six years. These lines are new, in the sense that they have never before been applied to the decoration of stoneware, and some of them are absolutely new. All the work I have spoken of is literal hand-work; no machine, other than the potters' wheel, has anything to do with it; no mechanical reproduction or pressing from moulds; no stamping out hundreds of similar shapes; nothing but what the eye and hand of the thrower, and the taste and good drawing of the artist, can manage between them, to which is added the colour that heightens all.

It will be remembered that, in my last paper, I called attention to the use of stoneware decorated with colour for architectural service. Much has been done since that time, and notably in the new buildings on the Albert-embankment, which are entirely built and decorated with bricks, terra cotta, and stoneware. Not a piece of stone is visible anywhere in the whole of that remarkable elevation. Many of our architects have seen the suitability of this fine material for decoration, but by the generality of them it is still neglected.

In all the separate links of this art manufacture, the one great characteristic—the individuality of the artist—is carefully preserved, and there are, in consequence, just as many ideas as there are designers to embody them. No one is working out another person's design who has any power of his own. It is, I venture to say, in this way that the interest and the character of the ware is kept up. Every few weeks brings a change of plan in the work. A few old favourites may be seen occasionally surviving the change. A few stock rosettes and other details are used frequently, but always in new combinations, and with original treatment somewhere. Thus, I claim for the Doulton ware a lasting reputation. It is not a mechanical art, sure to go out of fashion, but the living product of artists of taste and of thought, who feel an intelligent interest in their work, and a pride in its success.

I now come to a second part of my subject, that of Lambeth *faïence* and *impasto* ware. *Faïence* is a convenient term for any sort of earthenware that is not white. It is so called either from trade-name association with Faenza, where majolica was largely manufactured in the 16th century, or from a French town on the Mediterranean coast with a similar name. It is a name borrowed from the French, and, like many other other borrowed things, never returned to the proper owners. The name really has no clear meaning, but is a conventional term for painted pottery, on any ordinary natural clay as a body. Such pottery was produced in the Middle Ages exclusively, until the Italian potters of the 15th century borrowed from the Moorish potters of Spain the receipts for tin enamel. From this time, the tin enamel ware was used, almost to the exclusion of the *faïence* ware, for artistic and useful purposes. By this discovery, which poor Palissy broke his heart to find out (and which, by the way, he could have learned from any Italian potter, if he could but have met him, and induced him to talk on the subject), any common body of clay—a tile or brick, for instance—could be covered with an opaque, shining skin, on which the artist could paint with any colour he desired to use. This was very beautiful, but wore very badly, and the finest specimens are and were ornamental articles of luxury, carefully preserved until this day, and now may be seen in considerable abundance in every museum in Europe, and notably at the South Kensington Museum. Of this material is the so-called Rhodian ware, and several other kinds celebrated in their different localities. This ware held its own, together with various kinds of glazed earthenware, or so-called faïence bodies, until the discovery of china clay, which was made, not simultaneously, but within a few years of each other, by chemists in Germany, England, and France. The importation of porcelain from China and Japan had already partially spoiled the sale of the Italian and French productions, and the manufacture of porcelain itself in Europe put an end to the ware altogether.

The perfect surface of porcelain and its semi-vitreous fracture and imperviousness, and its white colour, gave it at once the place it so properly holds in universal esteem for household uses. The ordinary white earthenware of Staffordshire and other potteries is an imitation of porcelain, and is so good for common every-day use, and so cheap, that it must be long before it meets with a rival in the markets of the world. But the perfection of the material did not lead to any very high class decoration; china painting in Europe almost entirely went wrong, inasmuch as artists were attracted by the perfect surface to paint miniatures on it, and in no china that I am acquainted with has an attempt been made to rival the large and decorative treat-

ments that the material received in China, Japan, and Persia.

The small and exquisitely-finished productions of the European porcelain factories were eminently unsuitable for the decoration of the walls of our rooms. Hence the demand for a better, larger, more comprehensive treatment of *plaques* and panels, which should be of harmonious colour, not too elaborated, simply, and more artistically treated than could be expected from workshops or potteries where trade limitations of ideas prevailed. Again, there was a demand for colour, which the glaring white ground of earthenware bodies (much used for tiles) did not satisfy. Hence the reintroduction of our present faïence bodies and their popularity; the colour of the natural clay, not whitened, forms an agreeable base of operations for the painter; the range of colours is sufficiently extensive to do anything with, and, by the union of under-glaze colours with enamel, or over-glaze treatment, any colours whatever can be used.

This material has been taken into the service of the Lambeth pottery, and it has been with the desire to keep its range of decoration somewhat limited to the lines I have just sketched, that no great over-elaboration has been attempted. It allows of decoration, from the simplest expression of ornamental form to the finish of a miniature, and is equally fitted to form the base of a tile decoration, at two or three shillings a foot, as of the body of a vase, that will sell for several pounds. The examples here will show the great range of effects that different treatments give. For instance, these Lambeth imitations of Persian and Rhodian designs are perfect in their way, in good taste, well drawn, and a Lambeth translation of the originals not slavishly copied, but the differences of base, glaze, and pigment, have been frankly admitted, and the best made of the materials in the new line. The result is an intelligent work of art, charming in its harmony, and an ornament to any wall it can be applied to.

Fig. 11.



The same may be said of these landscapes, where the artist has accepted the limitations imposed on her by her materials, and seeks, not unsuccessfully, to produce effects bounded by these limitations. Again, I wish to point out that anything like over-elaboration has been carefully avoided; the effect of a *plaque*, as a whole, on the wall, is what has been kept before the mind of the painter; that effect, as a piece of colour or tone, being achieved, the detail is done as well as it can be, consistent with this limitation. So with figures. A few heads, and a figure or two, will exhibit what I mean. The effort to paint a head from nature, true to the model, would necessarily fail, from the uncertainty of the fire and difficulties of the pigment. Therefore, we say, let the head or figure have as much character as possible, but let the colour be first decorative and large in treatment, and afterwards as well drawn and as probable as possible. On these lines, I conceive we have avoided slavish copies on the one hand, and mere incoherencies on the other, and have obtained *plaques* that may, at least, claim to be good decoration. So also with the landscape and figures combined. Thus it is with several selections of design founded on the Japanese and Chinese artists. A liberal interpretation of the meaning of the originals has been made in the transcript, so that the character of the Lambeth ware is not lost in any false effort to realise effects obtained in a material unlike itself.

The ware that is, on the whole, most capable of receiving artistic impressions is that which is called *impasto* ware. It is so named from the special treatment it receives at the hand of the artist who decorates it. The colour is applied to the raw clay; it is, further, so thickened by the vehicle by which it is incorporated, that it models the form as well as paints it. The small amount of relief that is thus given the ornament—coloured, as it is—adds to the apparent reality of the thing depicted, and is, no doubt, an additional power in the hands of the artist; it is also a snare, inasmuch as the treatment of this principle involves a knowledge of modelling, to some extent at least. And, without some acquaintance with practice of light and shade, it is quite possible to produce a design devoid of effect; too evenly distributed all over the place. But with taste and judicious use of the raised parts, this new material may add very considerably to the pottery painter's means of producing good work.

The command over the texture as well as the tint of the background is also a point to be noted, as the application of paint, which has considerable opacity of substance, gives a quality that is never reached by half transparent films.

The whole system is, to a certain extent, analogous to painting with opaque colour in oil, while the average pottery underglaze painting is very like the water-colour painting, where the reflection from the ground passes through the coloured tints and films of pigment that cover it. *Impasto* painting, therefore, has all the advantages that opaque *tempera*, or oil painting, possesses; it reflects light from its surface. The opportunity this raised or *impasto* work gives for a second colouring, with underglaze colours, is to be remarked as rendering the work of art capable of taking a refinement of finish in detail on the surface prepared for it in relief. There are two examples here; one, a simple pattern, of creamy white on a red-brown ground; the other, an

example where the power and beauty of the material are carried much further. (See Fig. 12.) The background of this piece, too, is a very interesting effort as decoration, by using two pigments of

FIG. 12.



different fusibility, but of well-chosen harmony, so that, when they run together, the effect of each is heightened. Various applications of this method have yet to be made.

The new writers on household decoration, who have been almost legion, have naturally remarked on the useful and beautiful decorations that are formed by tiles. There are most picturesque examples of their judicious use in thousands of Dutch and other farmhouses, and even in the fishermen's, a better class of bauer's cottages in the Low Countries. And, no doubt, Dutch William brought with him lowland taste and lowland artificers, especially potters, who introduced delft ware and tiles; from these, our introduction of tiles in our fire-places may be said to date; and, among the healthful revivals of these latter years, certainly the clean tile hearth and fireplace is one. This has led to a certain demand for cheap tiles for a variety of purposes of household decoration, and there are exhibited various different patterns, all fulfilling the conditions of flatness and good colour, and applicable to almost any conceivable use, cheap enough to form linings of passages, halls, and rooms. Among those of a better kind, I may instance a fine example by Miss Lewis.

In 1874, this large and important art section was only just taken up; therefore, no artists names were at that time associated with the work. It is now a pleasant duty to mention the names of some who have done well by their taste, good painting, and designing, and who have impressed their individuality on the work.

Miss Florence Lewis has a remarkable power of design and skill in painting, that is seldom surpassed. Her designs are of foliage, flowers, and birds; and, whether she is working out a large design or a small tile, her energy and power are equally shown. I mentioned a set of tiles that are exhibited here, as being a good and remarkable specimen of painted design.

Her sister, Miss Isabel Lewis, also gives great evidence of taste, although her original design suffers a little by the close comparison with her sister's.

Miss M. L. Crawley has made an important section her own. She early studied the Persian and Rhodian ornament, and now produces these beautiful examples of similar style to the great originals just mentioned, with clear drawing and excellent colour and distribution.

Miss Mary Capes has done everything; an inventive artist who experiments, and follows up the results thus obtained in a truly scientific spirit. Natural or convenient forms, geometrical or conventional ornament, seems to be equally familiar to this lady's experience.

Miss Capes has developed an excellent section, that of painting on stoneware already finished, with a dip, or single or mixed colours, and fired in the salt-kiln, with enamel colours. Certain examples rival some of the best qualities of Japanese art. The combination of textures and colours is often singularly happy.

Miss Katherine Sturgeon has taken the section of figure design, with considerable results. The heads she is able to arrange with studies from the model, have a very great sense of beauty, and good colour and effect. I insert one here. (See Fig. 13.)

FIG. 13.



Miss Mary Armstrong has translated original figure designs, by Mr. Marks, and other designers, with much delicate sense of beauty and good taste.

Miss Fanny Stable has taken the treatment of large surfaces by the Japanese as her model, and by the study of these great teachers, has succeeded in producing paintings of excellent interpretation of nature.

Miss Mary Butterton, too, has done very much in original design, mainly treatments of natural forms, often circumscribed by geometrical limits, that are quite suitable to the form of the vase to be decorated. A firm decision of drawing is quite observable in her work.

Miss Alice Shelly has done some excellent treatments of natural flowers and foliage.

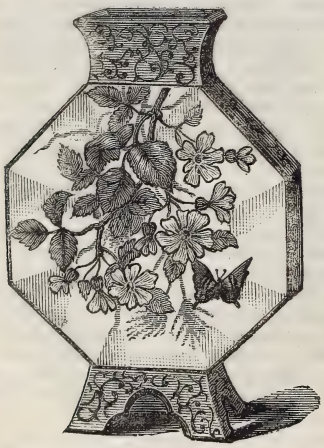
Miss Euphemia A. Thatcher has taken a similar style, in obedience to the constant demand for natural forms.

Miss Alberta Green, Miss Matilda Adams, Miss Margaret Challis, Miss Helen A. Arding (Fig. 14), and Miss M. M. Arding, may be mentioned as having done much that is graceful and good in various styles.

Miss Esther Lewis has done several landscapes from nature, from sketches in Wales, Switzerland, and other picturesque countries; they are entirely satisfactory, as broad, breezy representations of nature in quiet grey and warm tones. From any point of view they are equally good decoration and good art.

Miss Linnie Watt has a most distinguished gift for conveying the impression of a picturesque scene with rustic figures, in excellent colour and with artistic breadth of effect, quite admirable in its truth. Some of her works on the walls will speak for themselves to every artist who sees them.

Fig. 14.



The impasto painting was primarily developed by a very talented artist, Miss F. M. Collins, (afterwards Mrs. Vale). Her mark will sufficiently indicate her productions. She, too, we regret to say, has passed away from this world's activities, but not before she had made her gifts appreciated, and her great intelligence valued at Lambeth, in the care she took in the working out of a new and untried section of pottery.

Her successor is Miss Linnell, whose work is that fine vase to which I have already called attention (Fig. 10). Her treatments are in the largest style, and seldom run into trivial details.

No mention of names would be complete if I were to omit a short meed of praise to Mr. Arthur Pearce, who is a most prolific designer, and an excellent draughtsman at the same time. He has worked steadily at the School of Art, until now he is mainly relied on to make all the drawings wanted at the potteries for stoves, fireplaces, and similar sections. I can show you several of his tiles here, from which you will see that he is as versatile as he is ingenious. Among the many things he has attempted, is the section of tiles for German stoves, which, by the way, is an interesting thing as a matter of domestic comfort and economy. These beautiful stoves will shortly be produced in every variety of combination of open fire and closed fire, all being made to receive the most appropriate decoration.

When I last spoke in this room on this subject, I remarked on the absurdity and the wrong of importing designers from abroad to do our art work for us. I pleaded that we did not need it, and that if we did, we should not be helping forward what must be, or should be, of national interest to ourselves as English people, but on the contrary, should find we were grafting a foreign art on to a stock where it could never take natural root. I am convinced that the success of the Lambeth art pottery is a most excellent result of a genuine experiment, made with the capital and artistic taste of the manufacturer, developed by purely local means. I hope I am not in the least inclined to vain-gloriousness in speech, but I sincerely feel that no local school in any part of the Continent could have done more than the Lambeth school has done to back up, by its best efforts, the demands that have been made from time to time by Mr. Doulton. The reason is not far to seek. There is plenty of enthusiasm in our students, which is properly stimulated by the demand made on their time and skill, when these are enlisted in the work. Then the compact between the manufacturer and the artists is not merely a business matter; but I venture to think that every member of that select band of artists feels a sincere pleasure in knowing that the name of the firm with which he or she is connected is being extended in all artistic circles and countries, and they all feel, moreover, a wholesome pride in the reflection that they have done their best to earn this well deserved tribute of praise. That is one great factor to the steady advance the ware has made in artistic estimation. Another is the excellent supervision and organising power brought to the work by Mr. Rix. Then the firing of the stoneware, under Mr. Speer, is exceedingly well done, so that it could not be better.

The whole result of the few years' work is the more gratifying, inasmuch as we started in a perfectly new venture, without a single grain of experience to help us in the composition of stoneware colours, and with almost everything, except the general knowledge of the ware, to learn. You see how well the lessons, bought by experience, have

been learnt, and can judge of the success the Lambeth Potteries have made.

It is a truly national production, inasmuch as not a single stoneware-producing district abroad has attempted to develop anything out of the art taught them by their ancestors; it is local, and is the direct outcome of the proper co-operation that ought to exist between schools of art and local manufactures. As a local production, it has given the means of livelihood and intelligent occupation to more than 150 persons, the large majority of them being ladies and young girls, who, without this work, would have contributed, perhaps, but little to the stock of enjoyment the world has in beautiful things, a contribution that you see they are quite capable of making. Further, they are not supplying the demand for a thing that is likely to be a fashion for a time only; thoroughly good and beautiful pottery is to last for ever, and the demand for it will never cease so long as civilisation remains.

As I know that the past six years has developed a new art in stoneware, and almost a new art—at any rate in Lambeth—in faïence painting, so I venture to predict that another six years in the future will see as much advance on what we look on to-night, as it is in advance of what we saw in 1874, as all the conditions are present for bringing about the result.

Finally, I venture to think that the Lambeth art is in no danger of decline so long as the wise liberality of spirit of Mr. Henry Doulton encourages healthy, independent thought, and its expression on the part of those artists he is able to subsidise; and so long as these designers continue to learn the lessons their reading and observation of all great schools of ornament teach them, namely, that it is only by strenuous study, and continuous reference to nature, that they will be kept armed against that mannerism which has ever been the precursor of the death of all that is highest and best in any art.

DISCUSSION.

The Chairman said he had followed the progress of this ware for many years, and he could truly say that in no other country in Europe was there an instance of such an alliance as that of which they had seen the results in the Lambeth potteries, between the intelligent, clever master of the Lambeth School of Art (now the honoured head master of the South Kensington Classes), and the liberal, generous manufacturer whom they recognised in Mr. Henry Doulton. When you found two such men working together for one great end, you had an example which all the world might follow. It was very remarkable how this manufacture had sprung into existence, when hardly any one was aware that it was even thought of. At the Vienna Exhibition it attracted great attention, and in Paris it was praised so warmly that he hardly thought anything stronger could be said in its favour; but, if the then critics could have been present now, they would certainly be astonished at the advances which had been made even since then.

Mr. John Leighton, F.S.A., said that, while looking at the remarkably beautiful specimens of Lambeth ware around them, it was hardly possible to conceive that all had been created since the last London International Exhibition of 1862. Yet such was the fact, for the display of Messrs. Doulton, then, was of the most utilitarian character, and consisted of little more beautiful than stills, retorts, drain-pipes, and beer-bottles. Having collected many specimens of ceramic art, including several from the Japanese Court, he looked in vain at the Lambeth pottery ware, though he then purchased the best specimen he could obtain. This, though quaint in form, has little pretentions to colour or decoration; but he would place this jug beside the beautiful specimen of incised green work, as a contrast the most complete. Of the Lambeth ware the great French faïencier, Dech, spoke most highly, he being enchanted with the material and the future of this most enduring of all the art creations. In architecture, it would, doubtless, play an important part. The outlined *plaques*, marked with the styles and filled in with dull neutral tints, would be most effective, and particularly so when burned without glaze, and used in union with brick.

Mr. George Wallis, F.S.A., thought Messrs. Doulton were greatly to be congratulated on the display made that evening, which, to those who, like himself, had watched the development of this industry, must be a source of infinite satisfaction. This progress was a lesson to the nation, and to every manufacturer in it; a lesson to every artist and every inventor, because Messrs. Doulton and Mr. Sparkes, beginning with very small things, had gone on step by step, feeling their way under certain difficulties, and yet with many advantages, until they had built up an art manufacture of which the results were now exhibited. Happily, there had been no temptation to stray from the right path through abundance of means; the pallette had not run away with the painter, as sometimes happened, but here there was a steady progress. Taking some of the simple articles exhibited in 1871 and 1872, of which he was the fortunate possessor, simple white vases, with a few lines and a little bit of colour, there was no pretence about them, but they were infinitely tasteful and very beautiful. From that they had gone on step by step, and he began to fear, the success being so great, that they would find the colours running away with the artist, but such had not been the case. Happily, the very difficulty of the manufacture had been one of the great causes of success, on account of the restraints which it imposed, and which brought about the sobriety of form, of decoration, and of colour, which lent so great a charm to these works. He hoped Messrs. Doulton would never be able to get more colours than they could use with good taste, and that they would still observe the same wise restraint they had hitherto. This law of restraint was frequently the last thing learnt in the practice of art. There was one other point on which there was great cause for congratulation in this matter. One great difficulty in this country with regard to art as applied to manufactures, was that the artist was buried under the manufacturer; he got no *Kudos* out of his work; and some manufacturers would even go so far as to say that they were afraid to praise their workmen publicly, for fear someone else should run away with them. But there was nothing of that sort here; Messrs. Doulton, by the aid of the Lambeth School of Art, got round them a corps of artists, and gradually organised their industry; they recognised their talent, not merely in a pecuniary manner, but by bringing their names before the public, and giving them the credit of what they had done. Artists were a peculiar race; they belonged to the *genus irritabile*, and a little fame went a long way towards the work being well done. There everyone concerned had his due meed of praise, and this fact had, no doubt, much to do with the success of the experiment.

Mr. Henry Doulton remarked that there was great appropriateness in the chair being occupied by Sir P. Cunliffe Owen, since it was in great measure owing to the stimuli of international exhibitions, and the desire to exhibit something creditable to his country, that this manufacture had been developed; and in connection with the exhibitions the Chairman's name was well-known

as one of the captains in these peaceful battle-fields of commerce. He would observe that most of the articles now exhibited were the produce of the last two or three months; week by week beautiful things flowed through the manufactory, and it sometimes gave him quite a pang to let them go; in fact, he had taken home as many as he well could. The pieces now shown had been nearly all selected since he heard, about two months ago, that Mr. Sparkes intended reading his paper. It had been a great pleasure to him to be able to give healthy, interesting, pleasurable work to so many people. Division of labour, which could not be avoided, set men doing the same thing day after day, and, fortunately, some did not mind this sort of thing; but those who had the artist spirit in them could not do so with any satisfaction. It was, therefore, a great pleasure to him to see, day by day, the number of those increasing who were doing work in which there was some joy. In conclusion, he asked to bear testimony to the zeal, talent, and enthusiasm shown by his coadjutors—Mr. Sparkes himself being the guiding spirit of the whole; though, in his presence, he would not say anything further about him.

Mr. E. C. Robins, F.S.A., said it was very rarely one met with such a pleasing example of workman, artist, and employer, all uniting to produce the best work, each having his name associated with it. He felt greatly indebted to Mr. Sparkes for his account of what had been done; and he had to thank him for his services to an Institute which was now becoming popular, and which would become more so—the City Guilds Institute for the Advancement of Technical Education. They had erected some buildings at Lambeth for teaching the applications of art to industry, and Mr. Sparkes had, with great kindness, aided them with his advice and supervision after his labours elsewhere. In fact, he was always ready to assist in any movement which had for its end genuine technical or artistic education.

Dr. Dresser said he was rather amused when Mr. Wallis said he possessed some pieces of Doulton ware, because he supposed there were few houses in this country, occupied by people at all well-to-do, which did not contain some specimens. He was peculiarly interested in this ware, having been many years connected with art, and, as far as he knew, this was the first instance of the artist controlling the manufacturer. Those who had to design for manufacturers knew that in the great majority of cases they had to make designs adapted to their works, but Mr. Doulton had had the courage to allow Mr. Sparkes to control the art department of the manufactory, and the great results which had been achieved were, in a great measure, due to his practical sagacity in this respect. He must congratulate both gentlemen on the results they had achieved; but there was one danger ahead, which he thought must be guarded against. There was a tendency now, as manufacturing processes became more perfect, to trench on the domain of pictorial art, and to leave the legitimate track of decorative art. There were a few specimens there which seemed to him a little too pictorial, and some others which seemed a little cold in colour. He hoped he should not be considered hypercritical, for he really spoke in the interests of the manufacturer. There was one vase on the table which seemed to him too pretty—a pink one—though he might not be able to see it distinctly. His interest in this matter was increased by the fact that so much had been made out of a base and common material, being, in fact, little better than that used for ginger-beer bottles and drain-pipes. This was a matter of commercial importance, because, while they were impoverishing the nation to but a small extent, they were producing objects of art worth many pounds. At the present moment, he was experimenting with a similar object, but in a totally different direction, his endeavour being to see if common brick clay could not be rendered beautiful. He must say, that the idea of exalting a base material first occurred to him through the experiments of Messrs. Doulton and Sparkes, though he was so far from imitating them, that he would not have anything to do with making stone-ware, or with glazing by salt. On some future occasion, he hoped to be able to bring his results before the Society.

The Chairman, in proposing a vote of thanks to Mr. Sparkes, said it was to him a most pleasing duty, because he was proud to say he claimed him as a colleague. When the Lords of the Committee of Council on Education wanted a master for their training schools, they went to Lambeth for Mr. Sparkes, who, he hoped, would inspire the students at South Kensington as he had those at Lambeth. He had not only enhanced the reputation of Messrs. Doulton, but of his native country also, throughout the world. Though a hard-worked man, he was always ready to give advice and assistance to all who asked for it, and he deserved the hearty thanks of the Society for the paper he had now read.

Mr. Anderson Rose desired to second the motion, and in so doing, to protest against the terms in which Dr. Dresser had spoken of clay when calling it a mean and base material. It was a common material, but neither mean nor base; he feared it formed the greater part, not only of the present meeting, but of the whole world. Not being a friend of Mr. Sparkes, he was unable to enlarge on his merits, but he considered this was one of the most glorious exhibitions he had ever seen in England. He would also protest against Messrs. Doulton being induced to limit their manufacture in any way. If they found that man, woman, or child, had any special faculty or genius for art, either in the mouldiug of form, or in the imitation of nature, like Miss Barlow, he hoped they would avail themselves of that genius. Art might be congratulated that a man like Mr. Sparkes had found a man like Mr. Doulton to work with him, and inspire the workmen they had about them. He believed it was necessary, to bring forth the genius of the world, that those who occupied the higher regions of art should induce that genius to unfold itself for the benefit of the world. One man in Messrs. Doulton's employ, Mr. Tinworth, was certainly one of the greatest geniuses of our time, and the whole world was indebted to him.

The motion having been carried unanimously,

Mr. Sparkes, in reply, said that this industry had been developed under almost every disadvantage, except the hearty co-operation they had had throughout from Messrs. Doulton. The one object had been to produce a good effect, whether it would pay or not being a secondary consideration. Mr. Robins had been kind enough to say something about the small work he had been able to do in connection with the City Guilds. He had to thank him and his coadjutors for assistance which would lead in time to the formation of a great institution. The Guilds had greatly assisted them in Lambeth by building studios, which had been a great want, and the work would now have a better chance of development than it had ever had before. For instance, they had been able to establish a modelling school, which had prospered greatly under Mr. Dalon, and would, no doubt, continue to do so, although he was about to return to France. Further than that, they had afforded the means of paying additional teachers and professors. The means at the disposal of a school of art were very scanty; and the fees were so low, that the expense of carrying on an advanced class must be borne by somebody. In this case, the great City companies had come forward and provided the expenses which necessarily attended the working of an advanced class, and he was sure they would not go without their reward if they looked for it in a progres-

sive development of the artistic spirit and faculties. He quite agreed with Dr. Dresser, that pink was an abomination in pottery, but there was no such thing there; the vase referred to had an orange base. In the development of this industry, the difficulties overcome had been innumerable; but, fortunately, they did not all come at once. Any one who began to develop stoneware, as they had done, would want, not only almost superhuman patience, but a liberal-minded capitalist to take an unceasing interest in it whilst it was being done. The only thing which would save England as an artistic nation, was the following out of the independent lines of original ideas, of which this country was full. In the whole of the Paris Exhibition, there was nothing so remarkable to him as the number of ideas developed by our manufacturers in every section; in furniture, in pottery—all alike. Many things were unfinished, not nearly so good as they were going to be, but they were full of ideas. On the other hand, amongst the French exhibitors, there was plenty of excellent work, but mainly on two or three lines which were well known, and very few things to show that the minds of manufacturers and artists were working independently. In England they were all alive, and they had only to continue this, and try to work out the proper union between the manufacturers and the schools of art now being established all over the country, to produce something as good and original as the Doulton ware.

The collection of objects exhibited at the meeting will, by kind permission of Messrs. Doulton, be on view in the Society's Rooms to-day (Friday), and also on Saturday and Monday following. Members, and others bringing a member's card, will be admitted to view the collection.

MISCELLANEOUS.

INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION.

Dr. C. W. Siemens, F.R.S., read a paper at the Royal Society, on the 4th inst., in which he gave a detailed description of some experiments upon this subject, which have been conducted during the last two months at his house at Sherwood. The method pursued was to plant quick-growing seeds and plants, such as mustard, carrots, swedes, beans, cucumbers, and melons, in pots, and these pots were divided into four groups, one of which was kept entirely in the dark; one was exposed to the influence of the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for six hours each evening—from 5 to 11—and the plants were then left in darkness during the remainder of the night. The general result was that the plants kept entirely in the dark soon died; those exposed to the electric light only, or to daylight only, throve about equally; and those exposed to both day and electric light throve far better than either, the specimens of mustard and carrots exhibited showing this difference to a marked degree. Dr. Siemens only considers himself as yet on the threshold of the investigation, but thinks the experiments already made are sufficient to justify the following conclusions:—1. That electric light is efficacious in producing chlorophyl in the leaves of plants, and in promoting growth. 2. That an electric centre of light equal to 1,400 candles, placed at a distance of two mètres from growing plants, appeared to be equal in effect to average daylight at this season of the year; but that more economical effects can be obtained by more powerful light centres. produce no sensible deleterious effects upon plants enclosed in the same space. 4. That plants do not appear to require a period of rest during the 24 hours of the day, but make increased and vigorous progress if subjected during daytime to sunlight and during the night to electric light. 5. That the radiation of heat from powerful electric arcs can be made available to counteract the effect of night frost, and is likely to promote the setting and ripening of fruit in the open air. 6. That while under the influence of electric light, plants can sustain increased stove heat without collapsing, a circumstance favourable to forcing by electric light. 7. That the expense of electro-horticulture depends mainly upon the cost of mechanical energy, and is very moderate where natural sources of such energy, such as waterfalls, can be made available. In the discussion which followed it was pointed out that the evidence afforded of the practical identity, as regards vegetation, of solar and electric light, besides the probability that it would be turned to immediate account by horticulturists, would afford great facilities for the scientific investigation of the influence exerted by light, as compared with other agencies, in promoting the formation of the active principles or most valuable constituents of plants, such as the quinine of the cinchona bark, the gluten of wheat, and so forth. Before concluding his observations, Dr. Siemens placed a pot of budding tulips in the full brightness of an electric lamp in the meeting-room, and, in about 40 minutes the buds had expanded into full bloom.

NEW COMMERCIAL PLANTS.

Mr. Thomas Christy has just issued No. 3 of his series of pamphlets on "New Commercial Plants." These new plants comprise new medicines, fodder plants, oil seeds, &c. Pituri, about which a great deal of interest was felt a year or more ago, continues to attract attention on account of its stimulant narcotic properties. Mr. Christy quotes the statement of Dr. Bancroft, of Brisbane, as to its effect upon animals, and further says: "The active principle has been more recently eliminated by Mr. Petit, of Paris, whose researches are published in the *Journal de Pharmacie*. He identifies it with nicotine, the alkaloid of tobacco. The odour of the dried plant is also highly flagrant, like good tobacco. It remains, however, to be seen whether the plant contains any other active principle, as nicotine scarcely accounts for all these symptoms produced by pituri." The pituri plant is a native of Australia, and is referred to *Duboisia Hopwoodii*, of Mueller.

Amongst fodder plants, one of the most important and promising is the tagasaste (*Cytisus proliferus*). It is described as a shrub, native of the Isle of Palms, where it has been cultivated, as well as in the neighbouring Canary Islands for some years past, as a valuable forage plant. It thrives best in loose sandy or stony soil. In clay soils it does not do so well, and animals do not relish it so much. The roots penetrate very deeply into the soil, so that the plants can nourish themselves and produce a supply of green fodder even in the driest season. Its cultivation is, therefore, recommended for covering with vegetation the slopes which have been rendered sterile by the thoughtless destruction of trees and herbage. Full directions for sowing and cultivation are given in Mr. Christy's pamphlet. "The plants," it is stated, "may be cut once or twice a year, taking care to cut only from the most vigorous branches. A better yield is thus obtained, and this plant is less injured than if cut indiscriminately. The product of the third year may be considered as the normal amount, as the bushes are then full grown. Tagasaste has the advantage of containing a large quantity of nitrogenous matter. It is estimated to contain 1·136 of nitrogen, against 1·028 yielded by the finest clover hay. Each 100 lbs. of

3. That the carbonic acid and nitrogenous compounds generated in diminutive quantities in the electric arc fodder is calculated to produce 2·60 lbs. of meat. Animals, fed upon tagasaste, come into condition more rapidly, and to a greater degree than with any other food, except corn." For the daily food of a horse or cow it is recommended to mix 35 lbs. of fresh tagasaste with 20 lbs. of chopped straw. The plant grows well in the Eastern Pyrenees, Spain, and Italy, and it is stated to be especially suited for dry countries, such as the Cape of Good Hope.

It is satisfactory to find that the papaw tree (*Carica papaya*) is being recommended to the notice of Europeans. The properties of this tree, in causing tough or freshly killed meat to become tender, is well-known, and now that this action is proved on European authority, it is but reasonable to hope that some preparation of the papaw may appear in English trade.

SINGING IN PUBLIC ELEMENTARY SCHOOLS.

A Parliamentary return has been issued, on the motion of Sir Charles Dilke, corresponding to the return of 1879, giving the amounts paid in respect of the grant of 1s. for "singing" for the year ending 31st August, 1879. It appears that there was paid to 15,477 schools connected with the National Society or Church of England the sum of £70,662 2s. To 1,951 British and undenominational schools was paid the sum of £11,925 12s. The Wesleyan schools, 835 in number, earned £6,034 16s.; 1,235 Roman Catholic schools earned £6,809 14s.; and 5,203 School Board schools earned £33,248 6s. The total being £128,680 10s, which is an increase of £9,550 12s. on the grant for 1878. This large payment for "Singing by rote instead of by note," says Dr. Hullah, the official inspector of the Education Department, "from a musical point of view, is a mere sham." £128,000 is calculated to be sufficient to spread musical education over the United Kingdom, teaching music in elementary schools, night classes, schools of music in large towns, and giving students of great musical ability free scholarships in the National Training School for Music as suggested and established by the Society of Arts.

A NEW PATENT BILL.

The Bill brought in by Mr. Anderson, Mr. Mundella, Mr. Dalrymple, and Mr. Alexander Brown, to amend the law of patents for inventions, has been printed. The main alterations made by it in the existing law are as follows:—An officer will be appointed as Chief Commissioner of Patents by the Lord Chancellor, and a second and third Commissioner of Patents by the President of the Board of Trade. The suggested salaries for these officials are, £1,500 a year for the First Commissioner, £1,200 for the second, and £1,000 for the third. The clause, however, relating to salaries, is printed in italics, thereby indicating that it is intended to be modified in committee. On the appointment of these three paid Commissioners, the functions of the three at present unpaid Commissioners are to cease, and are to devolve upon the new officials, who are also "to manage all the business of the Patents for Inventions office of the United Kingdom, and to perfect its organisation; more particularly in the matter of a library of records and registers, so indexed and arranged as to facilitate searches, and to be easily accessible to the public under such reasonable regulations and small fees as the Lord Chancellor may from time to time prescribe." Letters Patent are to be granted for a period of twenty-one years, subject to payments at the end of the seventh and fourteenth years. Existing patents are to be subject to extension on payment at the end of the fourteenth year of the prescribed fees. The fees are as follows:—Petition for grant of Letters Patent, £1 5s.; certificate of record of notice to proceed, £1 5s.; warrant, £2 10s.; sealing, £2 10s.; "on the specification," £2 10s. The cost of a patent for seven years would therefore be £10. The fee at the end of seven years is £25; at the end of fourteen years, £50. The total cost of the twenty-one years' patent would, therefore, be £85. The second reading of the Bill was moved in the House of Commons, on Wednesday, 10th inst., by Mr. Anderson, but the motion was discharged.

NOTES ON BOOKS.

Wood-working Machinery; its Rise, Progress, and Cultivation, with Hints on the Management of Saw Mills and the Economical Conversion of Timber. By M. Powis Bale, C.E. London: Crosby Lockwood and Co. 1880.

The author has attempted in this book to confine an historical with a practical treatment of his subject. The first portion contains the names of the chief inventors and pioneers in wood-working machinery, while the remainder is devoted entirely to practical and technical details. Although wood has always been so largely employed in the constructive arts, it is only of late years that machinery has been introduced in its working. Sir Samuel Bentham is placed by the author as first and foremost among the pioneers of wood-working machinery, his patents of 1791 and 1793 being remarkable examples of inventive genius. Mr. Bale describes in his successive chapters circular saw benches, timber and deal frames, band and fret saw machines, and the various machines for planing and moulding, steam mortising and boring, tenoning, dove-tailing, veneer-cutting, wheel and carriage making, saw and cutter sharpening, besides all the miscellaneous machinery in use. The whole is concluded with a chapter of rules and tables, and the book is illustrated by a series of engravings of the designs of English, French, and American engineers. The author observes that "the adaptation of machinery to common uses is, without doubt, increasingly necessary to the commercial prosperity of a nation, and has been exemplified by the success of American competition in some branches of manufacture. This can, in a measure, be accounted for by the low patent fees and high rates of wages in vogue in that country, thus encouraging inventors to perfect the smallest details in their machine construction, which tend either to lessen the cost of production, improve the quality, or increase the range of the work performed. The saving thus effected may, in a day, be infinitesimal, but when multiplied by months or years it assumes a gigantic total. This points, the author takes it, to the urgent necessity of assimilating our own patent rates—which bear heavily on the brain power of the nation—to those of other countries."

Lightning Conductors: their History, Nature, and Mode of Application. By Richard Anderson, F.C.S., F.G.S., Member of the Society of Telegraph Engineers. London: E. and T. N. Spon.

Mr. Anderson has here furnished an account of the rise and progress of lightning-rod construction from the memorable year 1752, when the first lightning conductor was erected upon his own house by Benjamin Franklin, down to the present time. The early history of the invention leads naturally up to the practical lessons which have to be inculcated. It is a notable fact, that in 1768, the Abbé Nollet was preaching a crusade against the danger of the Franklin rods in Paris, and that about the same time the Dean and Chapter of St. Paul's, in London, were appealing to

the Royal Society to furnish them with a good plan for a lightning conductor for their noble cathedral; and, that, nevertheless, an admirable series of instructions for the construction of lightning rods were issued semi-officially in Paris between the years 1823 and 1867, whilst in London, the Franklin rods had come to be dreaded and abused. In the year 1826, Mr. F. C. McTaggart, an engineer in the employment of the British Government, recommended the prompt pulling down of all lightning rods as perilous devices, and in consequence of his denunciations, the Governor-General and Council of the East India Company actually ordered, in 1838, that all lightning rods should be removed from public buildings throughout India, including arsenals and powder magazines, and were only brought to a better state of mind on the matter after a large powder magazine and coining-house had been, in consequence, destroyed. Mr. Anderson, in the progress of his historical sketch, draws attention to the important change made in the amended form of the French instructions, drawn up by Professor Pouillet, and issued in 1854, in which the earlier theory of a fixed area of protection, calculated from the vertical elevation of the rod, was declared to be unworthy of trust, and in which a much larger dimension of rod, and a much more complete continuity of material, than those previously adopted, were insisted upon. These instructions also very clearly enunciated the double function performed by the lightning conductor—the neutralising of the electric tension of the cloud, as well as the innocuous transmission of the lightning discharge. In a yet more recent revision of these instructions, published in 1855, Professor Pouillet dwelt especially upon the paramount importance of capacious earth contacts, and recommended that the connection with the earth should be made by a double system of deep and of superficial communications. He very resolutely and uncompromisingly insists that before all things very capacious earth contacts shall be ensured, and that the efficient maintenance of these earth contacts shall be periodically tested. He points out that the part of a conductor that is above ground is a mere appendage of the part which is beneath, and that the most essential function of the apparatus—the harmless dispersion of the electric force—is accomplished in reality by the part which is under the ground. He roundly states that whenever a building provided with an apparently good lightning conductor is injured by lightning, it will almost certainly be found that the result may be traced to a defective earth contact. He observes that there is good reason for the conclusion that Franklin himself was quite aware of this fact; and he quotes with emphatic approval a remark of Father Secchi's, when speaking of the necessity of providing a large surface for the discharge of lightning with the earth, to the effect that there can never be too much. Mr. Anderson draws attention to the necessity of employing only pure copper in lightning-rod work, because impure copper has often only half the conductive capacity of the pure metal, and in some instances is even inferior in conducting capacity to iron of the same dimensions. Mr. Anderson has placed on record in his book the singular circumstance, that the vote of the sum of £2,314 for a lightning conductor for the Houses of Parliament at Westminster, placed in the Civil Service estimates for the year 1865, was the first and last occasion upon which money has been appropriated to the purpose of protection against lightning by the House of Commons. A list of books, amounting to 95 distinct works, and to a much larger number of monographs, printed between 1663 and the present time, bearing upon the construction of lightning conductors, forms a feature of the book. There is a reference, also, to instances of damage done to public buildings by lightning since 1589. This catalogue gives locality and date for no less than 332 cases of serious damage to buildings by lightning.

GENERAL NOTES.

Institution of Naval Architects.—The meetings of the institution for the present session will be held in the rooms of the Society of Arts, on Wednesday, Thursday, and Friday, March 17, 18, and 19. The official business, consisting of the reading of the Annual Report of the Council and the election of new Council, will be brought forward at the first meeting, to be followed by the delivery of an address by the President (Lord Hampton, G.C.B.) Various papers on matters of interest to naval architects are down for reading at the following meetings.

Coffee Taverns.—At the annual meeting of the Coffee Tavern Company, held in the Rooms of the Society of Arts, on February 26th, the Earl of Derby seconded the motion for the adoption of the report, and remarked on the success of these taverns at Liverpool, Manchester, and other places. He said—"I think this at least may be taken for granted, that there is a real popular want to be supplied, and that, therefore, these concerns ought not to fail, except as every undertaking may fail, viz., in consequence of mismanagement. It is a very common thing to hear people say, when they are arguing against the well-known ideas of Sir Wilfrid Lawson and his friends, 'I am all for temperance, but I am against temperance by compulsion.' Well, I rather lean to that view of things myself; but there is another side of the question which, perhaps, we do not sufficiently consider, and that is, that in our great towns we are apt to have, not temperance, but intemperance, on something like compulsion. There are thousands of places were intoxicants are sold, but until lately there were very few places where a man could get a cheap cup of anything but that which would make him drunk. I fully believe that for one man who has taken to excessive drinking from his own deliberate choice you will find two or three, or perhaps a still larger proportion, who have done so because they have been drawn into it by example, by the influence of social habits, by the fact that a good fire, a warm room, company, and refreshments are practically not to be had without the accompaniment of liquor. I do not think the great consuming classes sufficiently understand how completely the publican and the tax-gatherer are one and the same person, as far as they are concerned. I do not think they quite realise, when they order six pennyworth of spirits, that they are handing over 5*d.* as their gift to the Chancellor of the Exchequer."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

March 17.—"The Art of the Silversmith." By W. Herbert Singer. A. J. Mundella, M.P., will preside.

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A.

April 14.—"The History of the Art of Bookbinding." By Henry B. Wheatley, F.S.A.

April 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt. Sir Coutts Lindsay, Bart., will preside.

April 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By Thomas Fletcher.

May 5.—"On the last Forty Years of Agricultural Experience." By John C. Morton.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

March 16.—"Transport and Trading Centres for Eastern Equatorial Africa." By Captain C. E. Foot, R.N. Sir Douglas Forsyth, K.C.S.I., C.B., will preside.

April 6.—"Art in Japan." By C. Pfoundes.

April 27.—"Iceland and its Resources." By C. G. W. Lock.

May 18.—"The Colonial Practice of Transfer of Land by Registration of Title." By Sir Robert Torrens, K.C.M.G.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

April 8.—"On Recent Improvements in Benzine Colours." By F. J. Friswell, F.C.S.

April 22.—"On Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

May 13.—"On some Physical Applications of Light." By Prof. W. G. Adams, F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course will be by Mr. R. W. Edis, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 15th...Royal United Service Institution, Whitehall-yard, S.W., 8½ p.m. Major A. S. Wynne, "Heliography and Army Signalling Generally."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned discussion on Mr. W. L. Huskinson's paper, "The Present Depression in English Agriculture; its Real and Assumed Causes."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Professor Hughes, "The Evidence of the Later Movements of Elevation and Depression in the British Isles."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. H. N. Moseley, "Hydroid Corals—their Structure and Pedigree."

Tuesday, March 16th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Captain Foot, "Transport and Trading Centres for Equatorial Africa."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Schäfer, "Physiology of Muscle." (Lecture X.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "The Purification of Gas."
Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. 1. Surgeon-General T. Graham Balfour, "Vital Statistics of Cavalry Horses." 2. Prof. Leone Levi, "A Survey of Crimes and Offences in England and Wales, from 1857 to 1878."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.
National Lifeboat Institution, Willis's-rooms, St. James's, S.W., 3 p.m. Annual Meeting.

Wednesday, March 17th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. W. Herbert Singer, "The Art of the Silversmith."
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Captain William Watson, "Thermometric Observations on Board the Cunard R.M.S.S. *Algeria*." 2. Mr. William Ellis, "the Greenwich Sunshine Records, 1876-80." 3. Mr. G. M. Whipple, "The Rate at which Barometric Changes traverse the British Isles."
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. Thomas Morgan, "Certain Grants of Land in Mercia." 2. Dr. Douglas Lethgow, "The Name of Shakespeare."
Naval Architects (at the House of the Society of Arts), 12 a.m. Annual Meeting. 1. Address by the President, Lord Hampton. 2. Mr. Benjamin Martell, "Causes of Unseaworthiness in Merchant Steamers."
Royal Society of Literature, 4, St. Martin's-place, Trafalgar-square, 8 p.m. Mr. James William Redhouse "A Theory of the Chief Human Races of Europe and Asia."

Thursday March 18th...Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Lumleian Lectures.) Dr. W. Roberts, "Researches on the Digestive Ferments and Preparation and Use of Artificially Digested Food." (Lecture II.)
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. H. M. Brewer, "Remarks on the Indigenious Timber, and on the Plants Introduced into New Zealand." 2. Mr. J. T. Carrington, "*Lithodes Arctica*."
Chemical, Burlington-house, W., 8 p.m. Professor Tidy, "River Water."
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. Ernest Pauer, "English Composers for the Pianoforte." (Illustrated.)
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Dewar, "Recent Chemical Progress." (Lecture VIII.)
Royal Historical, 22, Albemarle-street, W., 8 p.m. 1. Mr. George Harris, "Domestic Every Day Life, Manners, and Customs in this Country during the Seventeenth Century." 2. Rev. Charles Rogers, "Notes respecting the Chapel Royal of Stirling, with Excerpts from its Unprinted Register." 3. Mr. Llewellyn Jewitt, "Historical Remarks on the Punishment of Women. No. 2."
Numismatic, 4, St. Martin's-place, W., 7 p.m.
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.
Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. B. Haughton, "A Railway to India."
Naval Architects (at the House of the Society of Arts) 12 a.m. 1. Mr. N. Barnaby, "The Nelson Class." 2. Mr. Scott Russell, "The True Nature of the Resistance of Armour to Shot." 3. Mr. A. C. Kirk, "A Method of Analysing the Forms of Ships and Determining the Mean Angle of Entrance." 4. Mr. A. J. Normand, "The Steam Trials of H.M.S. 'Iris,' and the resistance of Screw Propellers." 7 p.m. 1. Mr. J. R. Ravenhill, "Twenty Minutes with Passenger Steamers on the Long Ferry." 2. Mr. Dixon Kemp, "The Stability of Yachts." 3. Mr. J. Scott Russell, "A Wave Line Form of Midship Section."

Friday, March 19th...Bankers' Institute (in the Theatre of the London Institution, Finsbury-circus, E.C.), 6 p.m. Mr. H. D. Jencken, "Some Points of Difference between the English system of Law and that prevailing on the Continent regarding 'Negotiable Securities,' namely, Bonds, Shares, Coupons, &c."
Royal United Service Inst., Whitehall-yard, 3 p.m. Major-General Sir Frederick J. Goldsmid, "From Bameau to Sonmeanse Bay."
Royal Institution, Albemarle-street, W., 9 p.m. Prof. Tyndall, "Goethe's Farbenlehre (Theory of Colours)."
Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Lumleian Lectures.) Dr. W. Roberts, "Researches on the Digestive Ferments and the Preparation and Use of Artificially Digested Food." (Lecture III.)
Philological, University College, W.C., 8 p.m. Mr. E. L. Brandreth, "A Comparison of the Gaurian with the Romance Languages Part II. Morphology."
Clinical, 53, Berners-street, W., 8½ p.m.
Naval Architects (at the House of the Society of Arts), 12 a.m. 1. Mr. W. John, "Cellular Construction of Merchant Ships." 2. Mr. W. Denny, "Steel in the Shipbuilding Yard." 3. Mr. H. H. West, "Steel for Shipbuilding." 4. Mr. Emil Bertin, "The Relation between the true Period of Waves and the Period as observed on Board a Vessel." 7 p.m. 1. Mr. J. MacFarlane Gray, "A Simplification of the Thermodynamics of Steam." 2. Mr. J. Flannery, "Some Recent Experiments in Artificial Combustion." 3. Mr. C. W. Merrifield, "J. Amsler Laffon's Mechanical Integrator."

Saturday, March 20th...Royal Institution, Albemarle-street, W., 3 p.m. Mr. G. Saintsbury, "Dryden and his Period." (Lecture IV.)

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FRIDAY, MARCH 19, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1880, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For.Memb.R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to M. Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

The Council invite members of the Society to forward to the Secretary, on or before the 24th of April, the names of such men of high distinction as they may think worthy of this honour.

APPLIED CHEMISTRY AND PHYSICS SECTION.

At a meeting of this Section on Thursday, March 11 (Prof. ROSCOE, F.R.S., in the chair), a paper on "Balmain's Luminous Paint" was read by Prof. C. W. Heaton, F.C.S. The paper and discussion will be published in next week's number of the *Journal*.

Messrs. Ihlee and Horne, of 31, Aldermanbury, E.C., the proprietors of the patent for the "Luminous Paint," have kindly undertaken to send a specimen of the paint to any member of the Society, who may wish for it. Any member wishing for such a specimen should send a stamped directed envelope to Messrs. Ihlee and Horne, stating at the same time that he is a member of the Society of Arts.

FOREIGN AND COLONIAL SECTION.

Tuesday, March 16th, 1880; Sir T. Douglas Forsyth, C.B., K.C.S.I., in the chair.

The paper read was—

TRANSPORT AND TRADING CENTRES FOR EASTERN EQUATORIAL AFRICA.

By Captain C. E. Foot, R.N.

Mr. Chairman, Ladies and Gentlemen,—I trust you will pardon me, a sailor, for presuming to deal with matters almost entirely connected with the land, and must plead as an excuse my deep and earnest conviction that the portion of Africa to which our attention is this evening directed, will prove a field not only for philanthropy, but also for commerce, such as has rarely been excelled. By the former, I mean the extinction of that curse of Africa, "the slave trade," and the following up of the work that has already cost Great Britain so many valuable lives, and such a vast amount of treasure, and in the suppression of which I have had many years' professional occupation on both the East and West Coasts. As to the latter, namely, commerce, why should not Great Britain still assert her superiority? Trade has, we are told, been bad, and we constantly hear of over-production; it is my desire to call attention to the mode in which commercial enterprise should be pushed, in a portion of the globe which appears to me capable of receiving all, and more than all, that this country can produce, and of giving us in return much that is valuable. Feeling so strongly on this subject, I some time since determined to see for myself what could be done in furtherance of civilisation and development, and, in prosecution of my purpose, proceeded to Zanzibar, having first visited Natal and Zululand, where I had the opportunity of observing the working of the transport system, both in connection with the army and the colony.

It was my lot to serve in the Naval Brigade during the Indian mutiny, from 1857 to 1859, and to cross the Rocky Mountains in 1861, before even the telegraph wire was laid, so I have necessarily had some practical experience in the mode of transport in foreign countries, and trust that the views which I shall presently express may meet with consideration.

Arriving at Zanzibar the 20th of last August, I set to work to organise my little expedition to the interior, receiving every possible assistance from his Highness the Sultan, Dr. Kirk, Captain Earle, R.N., and all on board H.M.S. *London*, and many other friends, for which I am most glad to have this opportunity of publicly expressing my thanks.

On the 1st September, I left Zanzibar in a dhow, which Messrs. Smith Mackenzie kindly placed at my disposal, and reached Saadani on the mainland the same evening. My party consisted of eleven men (natives).

Time will not permit me to give a narrative of the journey, and the places I visited off the route, and from Mpwapwa. Suffice it to say that, 20 miles from the coast, I reached an elevation of from 800 to 1,000 feet above sea level, and, at 160 miles—after passing through a park-like country in some places, and a highly cultivated one in others—crossed a range of hills of nearly 5,000 feet. The land then dips, by means of a series of basins, to Mpwapwa, which is at an elevation of some 3,400 feet, and 200 miles inland. Mpwapwa is the advanced station of the Church Missionary Society. Mr. J. T. Last was in charge, and for his kindness to me, and the valuable information he gave, I feel much indebted, as well as to Dr. Baxter, of this station, whom I met at Zanzibar.

After visiting Lakes Kimagi and Nzui, some distance to the south-west of Mpwapwa, I returned towards the coast by, in some respects, a different route, as I induced my pagazzi to go through the Poree La Simba, or Forest of the Lion, which, on our upward journey, they were afraid to enter, on account of the Massai, a warlike pastoral tribe, who had recently attacked an Arab caravan.

The great difficulty appears to me to be the entire want of an organised system of transport between the interior and the coast. As most people are aware, both imports and exports are carried by native porters, or pagazzi, hired at five dollars a month in the case of a white man, whilst the Arab employs slave labour, and has only to provide food for his men; it is, therefore, apparent that, at the very commencement of any commercial enterprise, the European has to contend with an almost insurmountable difficulty, unless he brings to bear that power of combination and organisation in which Africans and Asiatics are almost wholly deficient.

In my own case, though I received every assistance from all in authority, it took me many days to get my small party of eleven men together. They had to be, as it were, recruited, medically examined,* sworn to an agreement at the Consulate, to have an advance given them, with time to spend it, together with the purchase of arms and ammunition on my part, and various kinds of cloth and beads for their maintenance by the way. It is also important that the porters should be, to a certain extent, drilled, as gun accidents are frequent; and though they insist on being armed, yet, in any danger, they throw away guns and loads and make for the bush, whilst in camp they sometimes succeed in shooting either themselves or their companions. All these and many other hindrances have often been graphically described by Cameron, Stanley, and others, and I only allude to them here to draw attention to the difficulty of conveying oneself, to say nothing of merchandise, a few hundred miles inland.

If, on the other hand, we look at the matter from a commercial standpoint, we should find that any European proposing to establish a house at Zanzibar, for the purpose of trading direct with the interior, and opening up branches at Kidudwe, Mpwapwa, Unyanyembe, or Ugigi, would discover that the cost of transport, independent of risk, would render his efforts to compete with the Arab trader, who pays in slaves, and deals in slaves by the way, simply futile. The slave trade by sea, we hear, is at an end, and so I trust it is, thanks to the vigilance of our cruisers, the boats of H.M.S. *London*, and the disinterested exertions of the Sultan. But, as regards the land

* This is very important, especially with carriers, as they present themselves and declare they are perfectly well and sound; although, after a few days' work, weak points become apparent.

traffic, it still exists, though not to so great an extent as formerly; and although I saw no slave gangs in chains, as in the old days, some three or four thousand, nevertheless, reach the coast each year. Many of these are absorbed on the coast, and only a portion are smuggled over to Pemba and Zanzibar. Slaves are often exchanged on the way down from the interior for bullocks or ivory. In one instance, where I wanted to purchase the tusks of an elephant just killed, and offered the chief the choice of all I had, he would not deal except he got a slave for each tusk.

Were unlimited means at command, a railway or a road, over which wheeled vehicles could travel to the Lake district, might meet the case; but, as I fear the millions necessary for the former of these undertakings is not likely to be readily forthcoming, I venture to draw attention this evening to a sketch of what may be done with existing materials, utilising and improving the means already at disposal, and opening up existing trade routes.

By European commerce alone, the interior slave trade can be abated, and ultimately stamped out. It is, therefore, of vital importance that some steps should be forthwith taken by philanthropists, as well as by commercial men; the former would best attain the results they desire by increased security and facility for missionary work, to say nothing of the suppression of the traffic in slaves, whilst the latter would open up fresh and most remunerative fields in the immediate future.

What I propose, is that an association be formed, or organised out of agencies already existing, for the purpose of forwarding mails, goods, and whatever else may be desired, to and from the interior, for establishing trading centres for neighbouring tribes, and, in cases where local labour was procurable and land suitable, for systematic cultivation.

A certain number of pagazzi, or native carriers, must be enrolled, each man to enter into an agreement to serve the association in any capacity required, and for a specified time, receiving a slight increase of pay each year, with other advantages for good conduct, and every man being subject to a certain amount of drill.

Discipline would immensely facilitate all work, as well as decrease the danger of African transport and travel, and that a body of natives can be got together and trained, has been amply proved by the Sultan's army, recently organised by Lieutenant Mathews, R.N. In her Majesty's ships, also, we have evidence of what the Africans of these parts become under discipline. Very many of the Seedie boys, as they are termed, are released slaves; and during the time I commanded H.M.S. *Daphne*, several instances of bravery on their part came to my knowledge. I consider them superior in courage, though not in physique, to the Kroomen, who are employed in the cruisers on the West Coast. It will be remembered how the Ashantee campaign proved the use of native carriers; and the first step taken by Sir Garnet Wolseley on his arrival in Natal, was to organise a corps of Kafirs, thus at once successfully grappling with the difficulty of transport, which before had been so unmanageable.

Time-expired petty officers and men from the Royal Navy would, in my opinion, be most useful in the organisation of this pagazzi corps, and I hope this most trustworthy class will be largely employed, where Europeans are required, for work of superintendence in Africa. The habits of discipline and of obedience they have acquired, together with their general handiness and adaptability, are of immense importance, and, being accustomed to constant change of climate, they are less liable to be injuriously affected by tropical heat. My suggestion, that they should be employed in connection with the industrial management of mission children, was well received by high authorities at Zanzibar; and the unqualified success of training ships, not only for our seamen of the Royal Navy, but for the mercantile marine, points out that we cannot have better instructors for the natives, or those who would more ably fill subordinate positions, than these time-expired seamen, bearing a good character from the Royal Navy.

In addition to the men, and as traffic increased, I believe beasts of burden—viz., elephants, mules, bullocks, and donkeys—could travel with immunity from tsetse, were the stations formed, and roads sufficiently cleared to permit them to pass with their loads; and light carts, in a short time, might be able to travel between some of the stations.

The much-dreaded "tsetse" fly is about the size of, and closely resembles, the common house fly of Europe, except in one essential particular, by which it may always be distinguished. This is that, when at rest, the wings of the tsetse, lying along the back, overlap at the tips; its body is, also, somewhat broader and flatter. It appears to be confined to Equatorial, and to some portions of Southern Africa, and to be extremely local in its habitat, some districts being infested by it, whilst in others, a few miles distant, the natives graze cattle with impunity. One bank of a river for some distance along its course will be "tsetse country," whilst the opposite will be quite free. It is stated tsetse districts can be safely passed through after sundown, the insect not being nocturnal. The bite seems free from any serious consequences in the case of human beings attacked by it, in common with other mammalia. Of imported animals, the Indian elephant appears to be "tsetse proof," as the public-spirited experiment of the King of the Belgians has, I think, proved.

It is a curious fact in Zululand, and no doubt applies to other parts of Africa, that once the wild buffalo is driven away the tsetse disappear, and it is not necessary to banish other game. I believe, if animals have to travel through a tsetse district, an occasional application of paraffin oil would have a beneficial effect in deterring the fly. As it is, Monsieur Broyon, whom I met 100 miles from the coast, had a cow that had been four times to Unyanyembe, and numbers of donkeys and cattle accompany the various caravans marching to the coast.

As to elephants, I believe they will prove of great importance. Only the other day I received a letter from Captain Carter, in command of the King of the Belgians' expedition, tending to confirm this opinion, as the following extracts will show:—

Kwilharah, Unyanyembe, Central Africa,
November 1st, 1879.

Thanks for your letter of 22nd September, which reached me yesterday, and I am indeed sorry we did not meet at Mpwapwa for many reasons. I have had rather

a hard time of it since I left Mpwapwa. Food for elephants scarce and bad, and the water the same; however, I am happy to say I arrived here on the 23rd October with my two remaining elephants in perfect health, though, goodness knows, they have gone through enough to kill any elephants. And should H.M. the King of the Belgians honour me with the command of another elephant expedition, I will guarantee to reach the lake in two months. Elephants are certainly the animals for Africa, and I hope sincerely someone will go in for taming the wild ones as soon as possible. Sanderson would be the man for this work if they could get him, and, if not, I would gladly undertake it myself, if they would send me a few trained elephants and a couple of good men trained to the work. My elephants would not go near wild ones, and as to my miserable Bombay Mahouts, I don't think they would go near a wild rat. I leave this for Massikambe, on the lake (L. 7° S.), where I have to remain idle until the rains are over; I shall then return to Zanzibar for fresh orders. I mean to try a new and more direct route back (nearly along the 7th parallel of lat.), so as to avoid Ugogo and its extortions.—Yours, very truly,

H. Carter."

This evidence speaks for itself. Mr. Cotterill—well known as the fellow-traveller of the late Captain Elton, who lost his life on the journey from Lake Nyassa to Zanzibar, and whose valuable journals have recently been made public, writing to Mr. Gerald Waller, advocates the use of elephants, and is of opinion that the natives could be induced to turn their attention towards the capture of these animals.

Speaking from my own experience during the Indian Mutiny, I have no hesitation in testifying to the importance of elephants in that campaign, especially during the rainy season, when camels and carts were useless. That these gigantic animals will take to the mountain equally with the swamp is known; for example, their spoor has been seen on Adams Peak, in Ceylon, which is higher than 7,000 feet, and during my journey to Mpwapwa I saw their traces at considerable elevations, and in very rough ground.

Native cattle will prove useful for pack and draught purposes, as has been shown by Livingstone and other travellers, who accomplished much of their work by means of oxen. I should like to see the black water-buffalo introduced, an animal well known in India, Ceylon, and Egypt, where it is used for transport and various agricultural purposes. Mules and donkeys have also their share of usefulness, and I have recently learnt that pack donkeys are succeeding on the road constructed by Sir F. Buxton and Mr. W. Mackinnon. In my opinion, the hardy little Wanyennweizie animals will stand the climate and the work better than any others; but at present, in consequence of the ignorance of the natives of the interior, they are driven down to the coast without loads, and are not even used for riding purposes.

The mules accompanying the Algerian Expedition, which I met at Mpwapwa, had carried very heavy loads from the coast. These animals were imported direct from Algiers. I therefore see no reason why Cape and Natal mules should not do still better. Much care and supervision will, of course, be necessary in dealing with any beasts of burden. The African, at present, is totally ignorant of their proper treatment, and a pack-saddle wrongly put on, or a load injudiciously stowed, may, in one march, gall and disable an animal. I have not mentioned horses, as they are reported not to do well on the mainland, but no doubt experiments might be made even with them, and I would suggest horses bred on the Island of Zanzibar, together with South African and Somali ponies, and no doubt with care a breed of seasoned animals might be obtained.

I now turn to the stations, for I look on these as being as essential as the chain of forts established by the Hudson's Bay Company; and why should we not, with this example before us, avail ourselves of such a certain means of securing the object in contemplation? The position of these stations should be carefully selected, both as regards the water and general healthiness of the spot; it is not necessary to establish them in the immediate proximity of villages, indeed, it would be better to do otherwise. Let us take for instance, as one illustration, a spot half way through the forest of Kdudwe, about 70 miles from the coast, which appeared to me to be particularly suitable. Here there is a large rocky mound, forming an excellent land-mark for the traveller, the elevation alone affording many advantages, whilst water can be obtained at a depth of from two to three feet, the soil being abundantly fertile, and well timbered. A station being established, a certain number of the pagazzi corps would form the permanent staff, erecting for themselves the usual native houses and the offices for the association, to which might be added a dâk bungalow or rest-house, as in Ceylon, where the traveller finds shelter, and can procure food from the rest-house keeper, who, in India and Ceylon, is employed by the Government, but here would be an *employé* of the association, the whole being under resident European control, with a system of periodical inspection. Natives would soon gather round any settlement which they felt was under European control, and afforded security from marauding tribes, and agriculture and peaceful habitations would thus take the place of a wilderness now difficult and dangerous to traverse.

Take, for instance, the case of the first settlers in Natal—viz., Lieut. King, R.N., and Mr. Fynn, as it is narrated by Dr. Mann, F.R.C.S., in his interesting and instructive work, entitled "The Zulus and Boers." Describing D'Urban, he writes as follows (*vide* page 20):—

"Mr. Fynn constructed his store on the opposite side of the inlet, near to the spot where the River Umbilo flows into the inner bay, and Lieut. King planted himself close to the outlet of the bay, under the shelter of the sea bluff. Numbers of the fugitive and hiding Kafirs very soon gathered round the little trading settlements as servants and dependants, looking up to the English for protection. Such, in fact, was the first instalment and virtual origin of the re-peopling of Natal, which has since grown to 272,000, who now represent the Natal natives."

This was in 1824. Already at Mpwapwa the native population has largely increased since the establishment of the mission, which is a most important halting place on the road to the Lake districts; and the same thing has happened at Magila, under the management of the Universities Mission.

All through my journey, I was struck with the extent of cultivation, which far exceeded my

anticipations, and at no place more than in the valley, and on the slopes of the Nqura Hills.

A branch of the French Roman Catholic Mission at Bagamoyo has recently been established at "Mondo," in these hills, at an elevation of 1,500 feet. Cotton, coffee, and cocoa plants are there doing well, together with many European fruit trees, and the hospitable fathers gave me a real treat, in the form of a well-grown cabbage. The natives are well disposed towards Europeans, and will work for wages (*i.e.*, cloth). They, like all other tribes in these parts, are, however, superstitious, and much under the influence of sorcerers, who are frequently the cause of bloodshed, whole families, and even villages, being sacrificed at their instigation. An affluent of the Wami river runs through the valley, and appeared navigable for some distance for canoes, even then in the dry season.

Thus it will be seen that within 100 miles of the coast there are numberless spots suitable for plantations of all kinds, and offering a field for British enterprise, certain to yield, under just and careful management, a large return in connection with any organised system of transport, and forming links in the chain which must ultimately connect the lakes with Zanzibar; and I would especially bring under notice this evening, the utilisation of the country bordering on the coast, believing that in a short time the returns will be such that no fear need be entertained of a lack of produce or trade, even supposing the waterway of Zambesi and the lakes be used for conveying goods to the heart of the country, as suggested by many, and as I cordially hope it may. Depend upon it there is room for all, and we cannot have too many roads in Africa.

Banyans, or British Indian traders, are now afraid to leave Zanzibar and the coast. Security for themselves and for their goods would be sufficient to induce numbers of them to flock to the country, where they would act as gatherers for the native articles of commerce, and establish a bazaar. Being British subjects, they could not employ slaves, and would therefore at once give large encouragement to the association.

As to these articles of commerce, they have been frequently brought under notice; and I particularly remember a paper read here on the subject by my friend, Capt. Cameron; but I may mention the following as a few of those I myself met with, while travelling rapidly through the country:—Ivory; india-rubber; gum copal; beeswax; hides—a vast trade in the skins of wild animals could be started, and each station might have, attached to it, a staff of hunters; tanning barks; maize; sugar-cane, of finest quality; cocoanuts; pepper; cassava, or manioc; fibre for matting and ropes; oilseeds of various kinds; millet; rice; beans; tobacco; and cotton.

The cost of land at places where there are already tribes settled would be merely nominal. I found the chiefs, when asked, said:—"It is God's, and not ours to sell; but, if you want to settle here, you must pay me a few pieces of cloth for my goodwill." This appeared to me a most reasonable request.

In my opinion, these stations should not be more than 20 miles apart; but at first this could not be accomplished, and one every 80 or 100 miles would be an immense step in the right direction.

As to climate, I consider this compares most favourably with India and other tropical countries, and I see no reason why resident Europeans and their families should not do as well as in other parts of the equatorial zone.

Great mortality and sickness doubtless occurs amongst those travelling, as, for instance, in the Belgian expedition; but forcing one's way through an unknown country, exposed to the vicissitudes of climate, and, in many cases, neglecting the most ordinary precautions, is a totally different matter to a fixed residence where men can adapt themselves to circumstances and avoid exposure. I believe a fixed condenser for distilling water, for drinking purposes, would be of untold value. A plan for a small condenser, of a very excellent and serviceable form, has been designed by Mr. Harvey, Chief Engineer of H.M.S. *London*.

Hitherto, there has been but a struggle to penetrate to and through the unknown, each expedition or traveller vieing with all others to reach some distant goal. What I suggest is that the work be pushed gradually and by short steps from Zanzibar, upon which I look as the base of operations, bearing in mind that this can only be thoroughly accomplished by the employment of a disciplined body of natives, under the management of Europeans of high character. Suppose, to commence with, there were a depôt for the pagazzi at Zanzibar, or on the mainland opposite, with, at first, a weekly or fortnightly service, the sea portion being performed by a small steamer; in fact, a sort of ferry-boat, carrying passengers and goods; a mode of crossing, that in itself, independent of the land transport, would pay, as native traders would ship their ivory and goods in her, and thus avoid the risk and discomfort of the present tedious passage by dhow. At the depot, goods could be placed in charge of qualified Europeans, and under their superintendence forwarded to their respective destinations, instead of, as now, by a caravan constituted hurriedly from the dregs of the Zanzibar, or Bagamoyo population; whilst a reasonable rate of speed could be maintained by relays of men from the stations along the route.

For two hundred miles, as far as Mpwapwa and Chunioyo, no hongo, or blackmail is levied, and from what I learnt, I consider it would be a matter of no difficulty to subsidise the principal chiefs along the route to Unyanyembe and Ugigi, so that the servants of the association, who would be distinguished by a badge, could pass free; or else a small fixed tribute, or toll per head, might be paid, as suggested by Mr. Hutchinson, in his able paper entitled "The Best Trade Route to the Lake Regions of Central Africa," read at this Society 30th of March, 1877. If, as I expect, Captain Carter succeeds in returning along the 7th parallel of S. lat., he will strike Sir F. Buxton and Mr. Mackinnon's road, and we shall then have a route with Dar-Es-Salaam as a secure harbour for small vessels, or for the repair of large ones, and Massani Bay, where the King of the Belgian's elephants were landed, and only a few miles from Dar-Es-Salaam, as a port accessible to vessels of all sizes in either monsoon, and immediately under the Sultan's authority. I also trust that a route through the Massai country will be opened up, either from Mombassa, which is a good harbour, or from some other more suitable

sea port to Lake Victoria Nyanza; for produce from those parts would assuredly reach the home markets sooner and cheaper by this route than by any other.

No doubt, to many, the question of cost will occur. I have not been able to enter fully into that matter, but, from rough calculation, I may say that the carriage of a ton to Tanganyika, costs, at the present time, not less than £500. Under any organised system, and especially where beasts of burden, Indian carts, or hackeries were employed, a vast saving would be effected. No great outlay is, in the first instance, necessary. Roads in Africa are not macadamised; those at present in use are simply a series of paths worn, I cannot say cut, through the scrubby jungle, and nothing more than a sheep track over the open plain. Road-making, for the most part, means simply clearing the bush, and occasionally digging trenches on either side. Of course, a certain amount of engineering skill, or, rather, common sense, is necessary in laying out the track to avoid swamps, and to construct, at the most suitable places, bridges of timber, it being borne in mind that at present a fallen tree or suspension bridge of interwoven vines is all that is used by the native to cross streams, and in many cases the traveller has to ford.

The only road-making enterprise hitherto undertaken, is that from Dar-es-Salaam towards Lake Nyassa. When I last saw it, a few months ago, 50 miles were completed; and for this effort in the right direction, I believe Central Africa may thank solely the philanthropy of Sir Fowell Buxton and Mr. William Mackinnon. The chief difficulty experienced by Mr. Beardall, the engineer in charge, was to keep down the vegetation in the low land; for on the hills the soil was hard, and almost of the nature of sandstone. Mr. Beardall intended when I left, to run a small bullock cart, or hackerie, over 30 miles of the portion already made, and the Banyans and Hindis had gladly promised to avail themselves at once of this mode of conveyance. I am confident that an American spider carriage, or light Cape dog-cart, such as is used in Natal and the Transvaal, drawn by mules or Somali ponies, would answer for travellers.

As to the cost of the necessary buildings, it would be found to be very small indeed; the Wagogo, and, in fact, all the native tribes, are remarkably handy in such matters, five or ten pounds worth of cloth going a long way towards building a good house on the native principle.

The African will work for money, and, in many instances, exhibits remarkable intelligence, but he is not at present capable of commanding any large body of men, therefore we must have the European as the head-piece, although, in consequence of the climate, he is unfitted for manual work in the heat of the day. That free labour is gradually increasing, has been clearly proved in the past year, numbers of free labourers having been employed on the clove plantations of Pemba and Zanzibar, where, hitherto, none but slave labour had been used. The cost of pagazzi labour is five dollars per month, with an allowance of one doti, or four yards of Merikani cloth, as subsistence for 12 days, the half of that being represented by a shuka.

In conclusion, I trust you will pardon the roughness of this sketch, in which I have endeavoured to lay before you ideas arising from actual observation, and which have, I think I may venture to say, the approval of the Sultan and of Dr. Kirk.

It may be questionable whether any large cut and dried scheme would have any rapid success; but it is not questionable that the more supple and less costly plan of building up, out of material that lies ready to the hand, must carry with it the reward that would be a commensurate return for its modest outlay, and that would be an assured warrant for further healthy growth; and it is certainly time that British trade, languishing for want of fresh markets, should be pushed in this direction. I cannot but believe that the plan which I have now endeavoured to suggest is simple and easy of success, and might prove the pioneer of a lake navigation and central African railway system. To sum up; what is really wanted, is:—

1st. A system of transport by means of an organised body of natives, supplemented by beasts of burden and light carts.

2nd. A chain of protected stations along the route.

3rd. That these stations be so constituted as to form "centres of trade," as well as halting places for the travellers.

4th. That the whole system of communication and transport should commence from the natural and ready outlet for marketable produce, namely, the coast; and be organised in such a form that it is capable of gradual and well-planned extension.

Under judicious management, such a course of procedure would, I am convinced, independent of its mere commercial advantages, prove the most effectual means of putting a final stop to the dreadful traffic in human flesh, which has so long prevailed in these regions. For myself, as a naval officer engaged in active service, I may not be able to take an immediately active part in the organisation of such a scheme; but I may, nevertheless, say that any possible assistance that I could indirectly give in so excellent a cause, subordinate to the requirements of those more paramount professional duties, would be very anxiously, gladly, and cordially contributed.

DISCUSSION.

Rev. G. L. Badger, LL.D., said he had some knowledge of Zanzibar, and of the people of that district, but had never been into the interior of the country; still, he had listened with great interest to Captain Foot's scheme, because it seemed feasible, which was the great point. Other schemes had been propounded, which were far too grand for Africa, and, consequently, they fell to the ground. About a year ago, one gentleman proposed a railway from some point on the coast to the Lake district, but he did not think anyone present would ever live to see it; though, eventually, it might, perhaps, be made. There was this great objection to all schemes of that kind—that they certainly would not pay, and there were not many capitalists who would invest their money in a scheme which only promised to yield 3 or 4 per cent. in a hundred years time. Captain Foot's scheme was a modest and practical one, and he should be delighted to see it carried out. He had spoken of the missionaries being pioneers of civilisation in Africa, and so they had in other places, but he wanted to see commercial enterprise doing something also. As he understood, these trading centres would be for the purpose of providing means of carriage by mules, donkeys, elephants, or porters—the latter, probably, for some time—and in

this they would be very useful. He knew the difficulties which now existed; those who wanted to go into the interior had to wheedle and cajole the men to get them to start, and when they got them into the interior, they were obliged to threaten them, and sometimes to thrash them. If this scheme were carried out, there might be a number of these men at each station, who would be bound to carry goods from one station to another at a fixed charge, and he had no doubt that most, if not all, of the native merchants would avail themselves of them. But beyond that, Captain Foot wanted these places to be centres of civilisation, where the natives would collect and be taught agriculture, and good habits; and the influence of such centres under European control, would no doubt be very great on the surrounding country. But there were several things to be considered; one was the cost, which Captain Foot said he could not estimate; nor could he; but he did not think it would be beyond the means of many who were interested in Africa, and who could wait a certain time for their remuneration. Indeed, something of the kind had already been started by a French association; and though he did not envy our neighbours any mercantile or philanthropic enterprise in which they might engage, he did think it a little disgrace to ourselves, having had so much to do with Africa, to let the French go in first. Another important point was the selection of eligible spots; but there was an immense deal of information, now at hand, and this would not be a great difficulty. Another great point was to secure the countenance and support of the Sultan of Zanzibar. The country was nominally, if not entirely, under his dominion, and he felt sure he would be ready to co-operate in any sound undertaking. He had said so again and again; but he was a shrewd man of business, and repeatedly, when such things had been put before him, he had said, let them put it on paper, so that he might know on the one hand what they wanted him to do, and, on the other, what advantage it would be to his country. He could do a great deal, and it would be well if these stations were in some way or other under his protection, nominally, at least. Circumstances might arise when perhaps the people at these centres would be unable to resist attack, but the Sultan had now a thousand men, well trained by Lieut. Matthews, in his service, who would make short work with any 10,000 Africans. The Sultan was not only aware of Capt. Foot's schemes, but he had written to him (Dr. Badger) on several occasions, speaking of Captain Foot in high terms, saying he believed him to have the welfare of the natives, as well as the interests of his own country, at heart. He hoped, therefore, the trading community would take the matter up and find the means. He was sorry to see there was so little enterprise with regard to Africa, though everybody was crying out about the badness of trade. There was an abundant outlet for manufactures there, and now was an admirable time for making a commencement. The latest accounts he had read showed that cultivation was extending enormously, and the native traders were so enterprising, that they had almost driven the Europeans out of the market.

Mr. Campbell Johnston, F.R.S., was very grateful to Capt. Foot for his paper, though he believed that on this question he had got on the wrong track. He had himself taken an active part in the establishment of the free port in China, called Hong Kong, and he remembered the good results which followed the action of Sir Stamford Raffles in inducing the British Government, early in this century, to form a free port on the Malay peninsula, amidst a nation of notorious pirates. He had conceived the notion that peace and civilisation would be produced there by simply opening a free port, no Custom-house being established to supervise a single thing; but anyone being free to bring what he liked, and to take away what he liked. He had known Singapore from 1834 himself, and the consequence of Sir S. Raffles's policy was to change the whole character of the place for two or three hundred miles round. Those who were before notorious pirates, were transformed into industrious people, and an act of piracy was now hardly ever heard of. It seemed to him that the right way to civilise Africa was to follow the same plan, leaving the natives, who were accustomed to the climate, to bring the produce to the port, where every facility for exchanges should be afforded. If this were done, he would guarantee that in another generation we should have accomplished in Africa what no coercive means, no annexation, prohibition of arms or spirits, would ever accomplish. Let them have what they liked; treat them as men, not as children, and let them develop their own morality and civilisation in a natural way. Dr. Badger spoke in such high terms of the Sultan of Zanzibar, that it occurred to him it would be a very good thing if he could be induced to send one of his councillors to Singapore or Hong Kong to see what had been done there; and he had little doubt such an inquirer would return with a scheme based on what he had seen, and, perhaps, improved, which would be of immense advantage to the Sultan, and to the people over whom he ruled.

Dr. Badger said almost every part of the Sultan of Zanzibar's territory for a thousand miles along the coast was virtually free; 5 per cent. only was levied on imports.

Mr. Johnston said that made all the difference; he specifically referred to a free port with no Customs supervision whatever. Even one per cent. implied a collector, and supervision, and that prevented the development of trade. A man might see what he thought a profitable opening for trade by importing a certain article, but if there were a Custom-house, it was examined, and thus became known to all the world, and he lost the exclusive benefit which he hoped to derive.

Mr. Trelawney Saunders, after congratulating the Society on the success which had attended the meetings of this Section, and the large amount of valuable information which had been got together and diffused by its means, said Mr. Johnston could not mean to imply that a port like Singapore was established without any supervision or control, and without any duties being levied to defray the expenses. It was never a free port in that absolute sense; but simply in the same sense in which it now continued to be so. Its success was not due to being a free port; and the reason Zanzibar had not been so prosperous arose from the difference of circumstances. Singapore was the centre of a trade by water; it lay in the centre of a vast archipelago, extending in one direction for 2,000 miles, and of this remarkable character, that while surrounded by seas of the most stormy description, the interior waters could be safely navigated by boats. The whole trade at Zanzibar on the contrary was landwise. He thought Captain Foot's suggestion one of the most valuable which had been yet put forward. What we had to look to, was not the exertions of individual philanthrophists like Sir F. Buxton and Mr. Mackinnon, but the united exertions of a great trading corporation like the Hudson's Bay Company, and the other great companies. The principal movements now taking place on the African continent were due to missionary enterprise; and as yet there had been a miserable lack of enterprise on the part of those who should be foremost in such matters—the commercial classes. When one considered the want of markets for the produce of our mills in the north, and the responsibility this country was under to feed the mouths which were increasing by thousands every day, it was surprising that those concerned did not take more active steps in opening up markets for their produce. His impression was, that though Africa presented millions of unclothed people, who would be clothed if they could with our cotton cloths, traders failed to see that the right way to achieve this was not to take our goods there first, but to bring away their raw produce,

and give the people the means of purchasing our manufactured articles. The country was overflowing with produce, but had no market for its abundance. What was wanted was some organisation to collect this produce, which was in great measure running to waste, and to bring it to the ports. This Captain Foot had suggested, in the establishment of trading stations, which would become centres of European civilisation, but the authority and means of protection to life; and property at these stations could only be entrusted to some incorporated body, such as he had referred to.

Mr. Hutchinson (Secretary, Church Missionary Society) said Captain Foot's experience had, to a great extent, corroborated the views he had put forward on a previous occasion, when he advocated, in a general way, some such scheme as had now been suggested; and on that occasion he was pleased to find that Mr. Waller also agreed with him in the main. He quite agreed with Mr. Saunders as to the necessity for this matter being taken up by some organised body in this country, if any large measure of success were to be hoped for. With regard to roads, he believed there was very little use in attempting to form new lines; it was much better to follow the established trade routes. The trading centres with which they had to deal really clustered round Unyanyembe. The greater portion of the traffic found its way from there, and from the district to the north of it, and the missionary societies working at Unyanyembe often met with Arab traders there. The best interests of that part of Africa would be served by carrying the trade on the line between Bagamoyo and Unyanyembe as the chief centre. He had formerly expressed the opinion, that the only hope of developing this trade was, to encourage the Sultan of Zanzibar to move in this direction himself; and he hoped that the large assistance which the English Government had given to the Sultan would help in that direction. The Sultan should be encouraged to arrange the question of hongo, and settle with the chiefs up the country the amount to be paid. And if he could organise a transport service on the principle of the traveller paying a certain sum at Zanzibar, which should free him right up the country, and arrange for carriers in an official manner, it would go far to solve this difficult question of transport. His (Mr. Hutchinson's) society had to send large quantities of goods into the interior, and their experience was that to transport 1,000 lbs. of cloth required another 700 lbs. to defray the carriage. The transport was only by porters, and each man carried not more than 60 lbs. He had made some suggestions as to the best method of carrying the weight, and the conclusion he came to was that the old Indian canteen-shaped baskets with iron supports was one of the best plans. He did not attach much importance at present to wheeled vehicles, on account of the want of roads. They had a road made for 250 miles, fit for a bullock-wagon to go upon; but when the missionary who went up by it wanted to return, he found it all hoed up and planted, so that the road had disappeared. With the rapid growth of African vegetation, it would be useless to make roads unless there was a constant traffic upon them. Another point to be borne in mind was that there was no staple in the interior of Africa which would pay for transport. Slaves were gone, thank God; and ivory was become so scarce, that King Mtesa could, with difficulty, obtain one fine tusk to send as a present to the Queen. It was, therefore, all nonsense to talk of flooding the country with 10,000 bales of cloth, because there was nothing to bring away in exchange for it. We must be content to work slowly and patiently. Capt. Foot's scheme was a modest and practical one, since it suggested dealing with an area of country which involved no great expense. They must induce a gradual growth of agriculture and commerce amongst the natives. If people were sufficiently disinterested to settle down at these centres, become familar with the people, and by degrees induce them to cultivate the land and exchange the produce, they would be doing a good work, but it would not pay in the commercial sense; it must be done on philanthropic principles. Their men had been some time at Unyanyembe; they had flocks and herds, and green corn, and vegetables, and the station was becoming self-supporting. When the King of the Belgians' expedition arrived there, they were in a position to welcome it, and were able to extend hospitality to sixteen Jesuit missionaries, who arrived in a starving condition. He had observed in the *Mission Catholique*, the organ of the society, a most glowing account of the kindness which had been shown them by the English missionaries. The time for any large scheme was not come; and he hoped the result of the discussion would be to try to induce the Sultan to introduce an organised system of transport. The time had come when the means which we had placed at his disposal to assist him in the suppression of the slave trade, and opening up of his dominions, should be turned to account; and when the Church Missionary Society, and others, who sent expeditions, should not be liable to have the agents murdered, as happened not long ago. In conclusion, he must repeat that they were much indebted to Captain Foot, who had done so much, at his own cost, towards the opening up of Africa.

Dr. Badger remarked, that Mr. Hutchinson had more than once referred to the great assistance the English Government had given to the Sultan of Zanzibar, and he should like to know what it was. Beyond 500 rifles, he did not know that they had given him anything. He might mention that when he was at Birmingham, or Manchester, with the Sultan, dining with the Mayor the Sultan's attention was attracted to a large painting of the Good Samaritan, and he had it explained to him. Some time after, when lunching at the Mansion-house, he referred to it again, and said, "You Englishmen, no doubt, think yourselves like the Good Samaritan, and the slave is like the man who fell among thieves; but who has been the ass who bore all the burden, but the Sultan of Zanzibar." He had given up an income of £20,000 a-year from the slave trade, and not only so, but had actually interfered to put it down, sometimes even capturing more than our own vessels did.

Mr. Waller said the question of transport was one of primary importance. The tsetse fly was an obstacle to the use of horses and oxen, and he feared donkeys would not prove of much service. The King of the Belgians had sent four elephants from India, but he believed only one had reached Lake Tanganyika alive, owing to the long marches they had to undergo, without either food or water. It was contemplated, however, to send some more in the summer. It had yet to be proved whether the Indian elephants would do to catch the African elephants, or whether it would not be better to try and get domesticated African elephants for the purpose. He believed they were to be got; at any rate, there was no doubt they could be tamed, as was proved by the one at the Zoological Gardens. It would be an expensive process no doubt, but it was worth trying, as each animal would be able to carry about a ton.

Mr. Johnson said there was a preserve of elephants at the Cape, and some could be caught if it was thought advisable.

Dr. Mann confessed that his own opinion was strongly in favour of the plan suggested by Captain Foot, as far as organisation went. There was no doubt that the wild races in Africa were signally open to the influences of trade, as was shown by the fact that traders were going into the Zulu country at the time war broke out, and "Cetywayo's Dutchman" remained in the country during the whole period of conflict, and came out alive. This was also shown, in a remarkable degree, in the early days of Natal. But the moment traders began to advance any way into the interior, the system of black-

mail was introduced, which put a stop to trade, and this could only be suppressed by means of a good organisation. It would, of course, be pleasant to know that trade was going on, and that large gains were, in that way, being made, but he must say that his own interest in this question was mainly that of the ethnologist. The question was always before him, what where the capabilities of the races of this vast continent; races which would not be destroyed, but were there waiting for some great future opportunity. They all knew that the skulls of different races expressed more clearly than anything else what their respective capacities were; and English people possessed, in the museum founded by John Hunter, at the College of Surgeons, one of the finest collections of sculls in the world. Until recently there were, however, no specimens from that part of Africa now under consideration, but, within the last few days, he had been the means of contributing five Zulu skulls, and he had examined these with Professor Flower, one of the first authorities of the day. They were all from the field of Isandhlana, and were, undoubtedly, those of Zulus of pure race; one was said to be that of an old woman, but it was of rather a masculine character, and there might be some mistake about it; but, with regard to the other four, the first thing which struck the scientific eye was that they were distinctly typical. No one having seen them could fail to recognise the same type again. The next point was their remarkable capacity. One of them appeared, speaking roughly, to show more capacity for brain than any European skull in the collection, save one. In the measure of skulls, there were certain standards which had been carefully and accurately determined, with which any individual specimen could be compared; and, in looking at these four skulls, so far as it had yet been possible to examine them, they were all found in these several tests of cranial excellence to be only just below the European standard; they were probably superior to all other barbarous skulls in the collection. There could not be a doubt, therefore, that these people possessed very superior capacity, which would be sure to come out when opportunity was afforded them.

Mr. Wylde (of the Consular Department) said he had listened with great interest to Captain Foot's scheme, which seemed very practical, and the only one which had a chance of being carried out in a reasonable time. No doubt the African continent offered a vast field for commerce, which only wanted development; but it was impossible to develop any country without means of communication. They had heard that it cost £500 to carry a ton a certain distance into the interior, and of course it would cost about as much to bring away a ton, and what produce was there which could be profitably carried at such a cost? One of the first requisites to trade was peace and tranquillity in order that people might carry on their operations without fear of being swept away by slave traders. Slavery was once the natural condition of things, but it was fast passing away. It had passed away on the West Coast, and the result had been a development of traffic quite equal to what could have been expected in the short time which had since elapsed. On the East Coast the slave trade had been scotched, but not quite killed. There was, however, already a great increase in the trade; and when slavery was totally extinguished, he felt convinced that trade would increase to an enormous extent. It had been hitherto impossible for the natives to bring down their produce to the coast, on account of the slave system, which rendered it unsafe for peaceable people to approach the coast at all. One of the first things necessary was an organisation of the country in the interior, and if they could only get a man like Colonel Gordon to undertake the work, and bring the country practically under the sway of the Sultan of Zanzibar, as it was nominally, he had no doubt the thing could be done. Much was due to the Sultan of Zanzibar, who had done quite as much as we had to suppress the slave trade; he had not only carried out his treaty engagements with perfect good faith, but had gone much farther. Having taken a great interest in Africa for the last 25 years, it was very satisfactory to him to know that within that time we had added more to our knowledge of the country than in two centuries before.

Captain Foot, in referring to the discussion, said he had purposely avoided mentioning anything about minerals, though he had every reason to believe that very valuable minerals were to be found. He had seen ironstone, and he was not certain there was not gold. He had seen quartz, though the specimen he brought home did not contain the precious metal; and there was abundance of mica. Copper also existed, and in due time he had no doubt the mineral wealth of the country would be appreciated. Having drawn the attention of the meeting to a sketch lent him by Professor Tennant, of the cottage in which Dr. Livingstone died, which was about to be sent to Dr. Moffatt, he said the co-operation of the Sultan of Zanzibar was one of the main points which had come out in the discussion. He had had long conversations with the Sultan, and had told him his views. The Sultan listened attentively, and said that if any organised scheme were brought before him he should be glad to support it; he would give land, and afford his protection, but he could not be expected to find money. He did not see how an absolutely free port would be any advantage to the Sultan; he had to live by his revenues. The cost of the scheme would have to be worked out in detail, and much would depend on the scale on which operations were commenced. He should advise beginning near the coast, and extending gradually as the trade increased. Plantations also might be set on foot with great advantage. Coffee would grow well, and cinchona, which was very valuable; the cloves of Zanzibar were the best in the market. He could thoroughly testify to the hospitality of the Church Missionary Society at Unyanyembe, and was glad to know that it had been publicly acknowledged by the Jesuits. In conclusion, he begged to say that any labour he had expended in the cause would be amply repaid if he found he had been the means of aiding in the development of Africa.

The Chairman said he thought Captain Foot had struck the key-note of the discussion, when he said that the procedure he was advocating would prove the most effectual means of putting a final stop to the dreadful traffic in human flesh. All trade in Africa, until very recently, was carried on by means of slaves. The Arab merchants went into the interior, and brought down their merchandise by means of slaves; this system had now been nearly swept away, but nothing had as yet taken its place, because wherever an Arab trader appeared the inhabitants fled; they had not yet got over their dread of being seized, and probably would not do so for a generation. It seemed necessary, therefore, at first, that some impetus should be given to trade, and some help furnished to direct it into the right channel. The Sultan of Zanzibar had shown a most liberal and enlightened spirit, and it was fortunate for him that Englishmen like Captain Foot should be able to put before him schemes for facilitating transport and opening up the country. Such schemes ought to be encouraged, particularly one so practical and modest as that now suggested. In another place, about a year ago, he had heard a grand scheme for a railway put forward, with maps and drawings, showing a long train of trucks, with bales of goods; but he did not suppose they or their children would see such an idea carried out. He concluded by proposing a hearty vote of thanks to Captain Foot.

The motion was carried unanimously.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 17th, 1880; Lord Alfred S. Churchill, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Andrews, J. D. F., 5, Mount-street, New Charlton, Kent.
Griffin, James T., Seaton-house, Adamson-road, N.W.
Horne, William Cullen, 31, Aldermanbury, E.C.
Ihlee, Henry Ferdinand, 31, Aldermanbury, E.C.
Japp, Alexander H., LL.D., 13, Albion-square, Dalston, E.
Penning, William Henry, F.G.S., Granville-house, Finsbury-park, N.
Shearer, Hugh, 21, Great George-street, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bell, Major William Morrison, 40, Pall-mall, S.W.
Pierce, Josiah, 12, Beaufort-gardens, S.W.
Ross, David, B.A., Church of Scotland Training College, Glasgow.

The paper read was—

THE ART OF THE SILVERSMITH.

By W. Herbert Singer.

It is now quite impossible to say at what epoch silver first came into use; we know that gold must have been in general demand towards the end of what is termed the bronze period, from the number of gold ornaments that have been found in connection with bronze implements of that time. Gold being found in a native state, was at once fit for use, but silver requiring more preparation from its ore, had, probably, to wait longer, until man had devised some method of working it. It is not likely, however, that silver lay hidden long after its richer sister; and, when once known, its wonderful properties as an art medium were at once appreciated, and it soon quite superseded gold for all purposes but that of personal ornament. Thus we read in the Bible of vessels of silver much more often than of vessels of gold. There are no less than three hundred and five passages in Holy Writ, in which mention is made of work in the precious metals, and from these we gather abundant proof of the prodigal use of both silver and gold by the Hebrews. Space, however, will not permit me to do more than mention the many applications of precious metals which were made by the Israelites, or by those from whom we may suppose them to have learned their work, the Egyptians; nor can I, for the same reason, do more than refer, in the briefest possible manner, to the workmanship of the ancient Greeks and Romans. Homer refers to silver, but in terms which would lead us to suppose that it was then comparatively scarce. According to tradition, it was first used for coinage by Phydon, King of Ægina, about 869 B.C. We may safely conclude that, at the time of Homer, and long after, all decorative metal work, and also statues, were made by the hammer, out of thin pieces of plate, the different pieces being joined together by pins or rivets; this being long before the process of soldering was invented. Great progress was made in the modes of working metals between the age of Homer and the fifth century before Christ, the art of casting in moulds with a core being then first practised; and this new method was a most important step towards that grandeur of perfection which was hereafter gained by the people of this nation.

Three different processes were used by the Greeks in the formation and ornamentation of their silver work. The first was that of beating, by the hammer, thin plates into various forms. A thin sheet of metal was put upon a kind of cement, which yielded sufficiently to allow the requisite amount of relief; it was then worked upon with blunt punches of different shapes, the ornament or figure being gradually raised by the ground being sunk; it was, in fact, what is now termed *repoussé* work; and I beg leave to call your attention to six studies of a head that have been executed in our factory, and which I hope will plainly illustrate the method of working in this beautiful but difficult art. In the first, you see the outline of the head faintly dotted into the metal; in the second, the form is more distinct, having been traced round with a blunt punch, by which a very slight amount of relief has been obtained; in the third, we find this relief higher; and, in the fourth, still higher, as here can be seen the little punch marks, which have been made in driving back the metal in some places to obtain the requisite relief for other parts. In this study more attention has been paid to the detail; this is again to be observed in the next, and, in the sixth, you see the work completed.

The second process used by the Greeks was that of engraving the surface of the work with a sharp tool, or chasing; and the third, that of inlaying one metal into another, or damascening. These different methods were often united in one work; thus a plate was first beaten up into a pattern, and was then chased with the graver. Silver was more used for such work than any other metal, and Pliny observes, as a remarkable fact, that while so many had gained renown for chasing in silver, no one was similarly famed for working in gold. It should, however, be mentioned, that soon after his time, the fashion changed, and then we find gold-chased plate most abundant.

As with the plastic art, that, perhaps, under the guidance of Phidias, gained the highest point it will ever reach, so with this branch of it, which owed its perfection to the close relationship then existing between the silversmith's art and that of sculpture. The art of working in silver was, undoubtedly, in an advanced stage of progress, even in the heroic period, but it was now that it reached its complete development. The commencement of this wonderful result may have been due to Phidias himself, for some of the greatest Greek sculptors were also workers in silver.

I can only give a very rapid glance at the silver-work produced by primitive Italy. Before Rome had made herself the mistress of the world, the civilisation of the Greeks had been spreading through a great part of that country. In Sicily their influence was soon felt, and this province was famous for a long line of artists. Some parts of Italy seem to have had a civilisation even earlier than that of Greece herself. This refinement must have come from the East, but it was soon blended and absorbed in the superior culture of the Greeks. Of these nations, Etruria is especially interesting

to us, for it was through her that the art of Greece first reached Rome. The jewellery of this artistic people is still the wonder of all true workmen, it being in personal ornament that they excelled. When Rome could so easily command the services of such consummate artists as these, and their Hellenic brethren, it is easily understood that so warlike a people would not delight in following the quiet and peaceful paths of art; and it was by conquest, or by these artists in their employ, that the Romans acquired most of their artistic treasure.

With the decline of the political power of the Romans, sank also their artistic power. There are many causes which brought about this end. The love of change, which is ever so fatal to pure art, was one great reason. The nobles were satiated with beautiful forms, and longed for something fresh. The artists, therefore, had to create new and vicious shapes; this led them further and further from the noble paths of yore. It must also have been difficult to follow the old traditions, when work was brought into Rome from almost every country of the world, and the style of each in its turn was the whim of the hour.

The gradual decline that now commenced was but the beginning of the end, when almost all was swept away by the barbarians, as they crowded victoriously into Rome, to take that terrible revenge for which they had so long thirsted. But before this took place, the Romans lived on in the most most prodigal splendour, their luxury being such that we cannot even comprehend it. Gold and silver glittered everywhere, and were used to such an extent, that these precious metals almost passed out of the hands of the silversmiths, and became a material for the builder.

No two events, probably, caused such a complete revolution in the world of art, and therefore in the design and execution of every kind of metal work, as the conversion of Constantine to Christianity, and the removal, in the year 330, of the seat of the Government to Byzantium.

There can be no doubt but that the former of these events gave a great impetus to the art of silver working, and caused a great demand for such work, as, besides the costly gifts Constantine bestowed upon Roman churches, he endowed those at Constantinople even more magnificently. No sooner had the Emperor embraced Christianity, than he endeavoured to do honour to his new religion by making her temples and their contents as gorgeous and costly as possible, and his zeal must have been indeed great, for, in a very few years, Constantinople became the richest city in the world, and this was mainly due to the service of the Church.

It is most unfortunate that the writers who chronicle these riches do not give sufficient particulars concerning them to enable us to form an idea of their artistic merit; but, from the fact of the size and weight of the various objects being stated, we may conclude that the intrinsic value was more considered than beauty of form or delicacy of ornament.

The works now executed were probably debased copies of classical examples; for, as yet, little progress could have been made in the new art. The form, as being more difficult to invent, we must suppose was a more or less direct imitation of the older style, while the Christian artist would endeavour to change the detail upon it, so as to make his production more consistent with its fresh service. The example set by Constantine was followed by his successors, each Emperor striving to add some new splendour to the Eastern capital.

So late as the tenth century, Constantinople held the proud position formerly belonging to Rome, and from her came the light that dispelled the darkness over the rest of Europe; and if it were not so high and beautiful art as that emanating from the ancient mistress of the world, it was, at least, a strong, vigorous style that has retained its influence, even down to the present day.

The whole secret of the difference between the two styles lies in the fact that, as the Greeks especially cultivated beauty and purity of form, the Byzantine artists sought above everything beauty and richness of colour. This is particularly observable in studying the gold and silver work belonging to these periods.

In the great eras of art, these metals were used in their native state, and the forms into which they were worked were so beautiful, that they required no further help to make them perfect works of art. But this did not satisfy the more gorgeous, but less refined, taste of the lower Empire, and these artists were not content unless their metal work was resplendent with sparkling effect. This luxurious people delighted in splendid masses of colour; this they often obtained in their work by precious stones, grouped together without any regard to design, but the effect of colour. It was for this reason they brought enamelling to such perfection. The rudiments of the art they no doubt obtained from the East, where the enamel was applied to the metal in a thin layer by vitrification. But the Byzantine artists were the first to practise, in Europe, the art of *Cloisonné* enamel, by which process, each colour is separated from the other by a thin strip of metal.

We must not pass from this early period, without making mention of the important specimen of silversmith's art which has come down to our own time. I refer to the altar frontal in the church of St. Ambrose, at Milan. It is of silver, partly gilt, and in it are set, in great profusion, precious stones and plaques of enamel. It was the gift of the Archbishop, in the year 835; being a peace offering from him, to atone for the profanation of the relics of St. Ambrose, of which he had been guilty. Some attribute this work to Lombardian, and others to Byzantine origin, but its whole character seems to tend towards Latin art. It is, without doubt, one of the most important objects created by Christian art up to the year 1000.

There can be no doubt, however, that another most elaborate work of this age was created by Byzantine artists. I refer to the gorgeous altar frontal in St. Mark's, at Venice. This example is the finest specimen of the enameller's art that has been handed down to posterity.

The tenth century was, for Europe, a most disastrous period; war was so general, that the people had to study the use of a harder metal than silver. The general expectation of the end of the world, at the completion of a thousand years from the birth of Christ, was another cause of the gloom

and apathy which now depressed the whole of the West.

The eleventh century was a period of renovation. Romanesque is the term given to the art of this transitional period, which may be said to connect ancient art with the Gothic style. Now was commenced that movement which afterwards developed the beautiful forms of the thirteenth and fourteenth centuries. Artists were tired of seeking for the traditions of the antique; they, therefore, created new shapes, and their art was gradually moulded into that severe style, so pre-eminently ecclesiastical, which retained its hold upon the people until the era of the Græco-Roman style, 400 years later.

Towards the end of this century, and throughout the succeeding one, a large number of shrines were made; they are, in fact, the characteristic object of the age. They probably sprang up in such numbers, from the quantity of relics brought home by the Crusaders, when the want was naturally felt for a receptacle worthy of such holy treasures. The shrine is almost always made in the form of a coffer, the framework of which was wood, a sloping or gabelled top, overlaid with thin plates of silver or gold. The sides generally consist of a series of arches, within which are placed statuettes. The arcading is enriched with *cloisonné* or *champlevé* enamel, filagree work, or is set with precious stones. The figures are executed in *repoussé* work, in rather high relief, the head being, as a rule, quite detached from the ground. These figures have no longer the supple grace with which the lost style would have endowed them; they are now stiff and gaunt, each posing in a certain solemn grandeur under its rounded canopy.

About this time lived that remarkable monkish artist, Theophilus, who deserves to rank high amongst the art-workmen of old, for his wonderful treatise upon the various arts. Six of his manuscripts are extant, and in sixty-nine chapters he deals with the art of the silversmith. Unfortunately, he has fixed no date to his learned essay, and many of the best authorities have not been able to agree as to the age in which he lived. Some writers, such as Lessing, believe him to have lived as early as the ninth century; whereas the Abbé Texier, and others, reasoning from the knowledge he displays of glass painting, select the thirteenth as the period at which this work was produced. It is probable that the former have gone back too far, and that the latter assign too modern a date, to the time of the monk's researches; for, from the style of the work, and the terms he uses, it is more likely that he lived about the middle of the twelfth century. He mentions, in the preface, that "the Germans only, among the nations of the west, were famous for their skilfulness in the working of metals." He could not have written this much after the above-mentioned period, as, towards the end of the century, the French had quite equalled, and the Italians had probably surpassed them in their knowledge of metal working. This learned monk is so humble as to his own skill, and mentions so few facts with regard to himself, but so much of the arts in which he was so proficient, that it cannot even be decided to what nation he belonged. He commences his chapter on the working of the precious metals by mentioning the different tools that were required, and then goes on to describe minutely the various processes that it was then necessary for an artistic metal-worker to be skilled in, the requirements being so varied, that there are but few, in our days, who could fulfil them. He must be able to execute *repoussé* work in its many and difficult branches; also to engrave, and, if necessary, to compose the niello which is sometimes filled into engraved lines, to produce a stronger contrast; to understand the mixture and application of *cloisonné* enamel, and the setting of precious stones; he must also be able to model in wax, so as to make the patterns for objects to be cast in silver or gold, which process he must also be able to undertake himself. We thus see, from the standard held up by this author artist—who, from the way in which he treats the different subjects, must have been himself able to produce work in the various processes he describes—that, by the end of the twelfth century, the silversmiths had mastered nearly every difficulty of their beautiful art. It is, therefore, the more disappointing that so few specimens of this period have descended to posterity, most of the examples still extant being of German origin, consisting of either shrines or reliquaries. The treasuries of the cathedrals of Cologne and Aix-la-Chapelle are very rich in work of this time; in the former, is the shrine of the three Magi, which was commenced in the year 1190; in the latter is still preserved the shrine of Charlemagne.

One of the most famous examples of this period is an object made in our own country, which goes by the name of the Gloucester candlestick. It is executed in a white alloyed metal, containing a good proportion of silver. This interesting specimen is still preserved in the South Kensington Museum. In outline, it follows the general design of these objects, having a straight stem, with a knob in the centre, a triangular base, and a large receptacle at the top to prevent the grease from dropping, with a pricker to hold the candle; but it is remarkable for the marvellous amount of decoration with which it is covered, every member being loaded with ornamental detail. This consists of volutes and foliage, in the folds of which are grotesque figure of men, birds, and monsters. This form of candlestick was to be placed upon the altar, but the churches at this time were furnished with others which stood upon the floor of the church. From the earliest days of Christianity it had been the custom to light a large candle at the great festival of Easter, as a type of the new dawn given by the Resurrection, and this larger candlestick was made to hold the Paschal candle.

I have not yet mentioned an object which has ever received especial care from the silversmith; I refer to the chalice. This interesting object has not been spoken of at an earlier period, because, although there are records of the large number of chalices in use in the primitive church, we have but scanty knowledge of their design and detail. In the first days of Christianity, the chalices were of great size, to allow for the large number of communicants; but, at an early date, there was also a small chalice, in which the priest consecrated the wine, and, after his own communion, poured a small portion into each of the larger chalices, a sufficient quantity of unconsecrated wine being added. In many churches, these chalices were

hung up on the wall, around the altar, by their handles.

The chalice has been made of various metals and substances, such as gold, silver, copper, tin, glass, wood, &c., but it was more often made of silver than any other material, that being the metal most adapted to its various requirements; and it was forbidden by an early Canon to make the bowl of anything but the precious metals, the inside of the bowl being always quite plain, and also some distance below the lip on the outside. In the twelfth century the cup was reserved to the celebrant, and from that time the chalice was made of a much smaller size. The large two-handled chalices were, no doubt, of classical shapes, but sufficiently altered to make them applicable to their new purpose. The smaller chalice, in the earliest period of which we have any example, is of a massive character, the bowl semi-circular, with a rather small round base, and thick stem.

The silversmith's art of the Middle Ages reached the greatest perfection during the thirteenth century, continued to flourish throughout the fourteenth, and slowly declined during the fifteenth century. With the dawn of Gothic art, the heavy lines of the Romanesque style disappear, and are replaced by those elegant shapes, the value of which consist in the beauty of their contour, and not in the cost of the material in which they are executed. This style is essentially ecclesiastical, and is perfectly adapted to the production of objects in the precious metals for the service of the Church.

The pointed style of architecture marked a complete change in the silversmith's art. During the twelfth century, both the architecture and metal work of Europe had borne a resemblance, in many respects, to the productions of the Eastern Empire; but with Gothic art, that likeness entirely ceased. The artists who elaborated the wonderful pointed arch, together with the intricate tracery and columns of this period, had brother workers in the precious metals, who carried the art of the silversmith to the same pitch of excellence.

At the commencement of the century, we find that many of the silver objects then created, depend upon architectural detail for their enrichment. The little ornamentation with which such objects were decorated, was always exactly adapted to the shape in which it was placed, every part being especially designed for its own peculiar position. It was not, as in some periods of art, when the object was considered only as a means of showing off some elaborate combination of detail, of which the designer was so proud, that he would sacrifice beauty of form, and all else, so long as he was able to produce this specimen of his manipulative skill; in so doing, he often made his work almost worthless, by not observing one of the first rules of art, viz., that ornament is made for the object, not the object for the sake of the ornamentation.

During the next century, a great change again took place. The art of the silversmith now took a much wider range; hitherto, during the Middle Ages, it had been almost entirely restricted to the use of the Church, and a great majority of the workmen had been inmates of the monasteries; but many of the objects now produced were for the sideboards of the nobles, and the art may be said to have almost forsaken the cloister, and to have fallen into secular hands.

A large quantity of the silver-work now executed was remarkable for its bizarre composition. This characteristic is most evident in the hanaps, fountains, ewers, nefs, and salt-cellars. The articles for ecclesiastical use comprised chalices, crosses, censers, book-covers, burettes, and reliquaries.

In the preceding century, the reliquary almost always took the form of a miniature edifice; unless the work was destined for a cathedral, such objects now usually took the form of statuettes in silver, the general tendency of the age being towards the cultivation of sculpture, and this gave the silversmith an opportunity of displaying his skill in that art. The shape of the chalice also underwent a change. The bowl is made smaller, and is often semi-ovid in form, the base being frequently divided into lobes, the knop being ornamented with architectural detail, and upon each side of the stem is often worked a small arch with cuspings, the proportion of the whole being excellent.

Of secular art, the salt-cellar and nef seem to have claimed the greatest attention from the hands of the silversmith. By the frequent mentions made of the salt-cellar in inventories of this period, its size and weight, and complicated design, it being composed generally of numerous figures, we learn in what importance it is held by a mediæval host. Salt was the emblem of hospitality, no guest being placed below the salt. Thus so significant a piece of plate had necesarily to be a conspicuous object.

The nef was a work which enabled the nobility to display their richness and luxury. In shape it was a miniature ship, which formed a receptacle to contain the goblet, and other utensils, for the use of the person to whom it belonged. It was placed in the centre of the table, occupying the position of the modern épergne. As an example of workmanship, the nef is most interesting, as every part was made with the greatest care. Thus the ropes, sails, &c., are all found in these miniature vessels. Upon the deck men were often placed, and sometimes animals, these being executed with great skill.

It is curious to note that, while large and important objects are numerous, mention is made of only one fork in nearly every inventory of this time, this indispensable article being probably used for the first time about the middle of the fourteenth century, and then only for serving food from the large dishes.

There is but little to record of the silversmith's art in France during the Middle Ages. The first quarter of the fourteenth century was a most disastrous time to that country. Large quantities of plate were then melted down to enable the nation to carry on her war with England, and a great portion of what then escaped the crucible went towards the payment of the heavy ransoms demanded for the chiefs taken in battle.

Concerning silver work in England during these centuries, but scanty information can be obtained, and specimens still left to us are even more rare than in the neighbouring country.

This period had a dark commencement, under the auspices of King John. His son, Henry III., was a great admirer of the arts, and did much towards the development of artistic wo kmanship

in the precious metals. The greatest work undertaken during the reign of this King was the Abbey of Westminster. One object destined for this edifice—the shrine of Edward the Confessor—claimed his especial care, and, from documents, we learn what riches were expended upon the ornamentation of this costly gift. The shrine was commenced under the superintendence of Odo, but was not quite completed at the time of the King's death. William of Gloucester was also employed by Henry, the silver statue for the tomb of the Princess Catherine being by his hand. St. Paul's Cathedral was also very rich in works of silver. From the inventory of the objects in this cathedral, we learn that the service of the Church must have been performed here with great magnificence.

It was during the reign of Edward I., that a great part of France was under the sway of England. In the conquered district was Limoges, which accounts for the large quantity of enamelled works that were now introduced into England, and it would seem were greatly admired by the English, for the art was soon after largely practised in this country.

There are but few specimens of fifteenth century silver work left to us, the ecclesiastical plate with but very few exceptions having disappeared at the Reformation, and most of the plate in the hands of the rich nobles and commoners having been melted up during the civil wars. But, although the originals have long been lost, there are numerous dispositions of these former riches to be found in mediæval wills, from which we learn that many of the feudal lords were possessed of great riches in gold and silver plate both for ecclesiastical and domestic purposes. The merchant princes of the fifteenth century also had their treasuries well stocked with silver plate. Some of the London guilds, and colleges in Oxford and Cambridge, possess specimens of the latter end of this century, but they are probably not examples of the best work of the age.

The village of Nettlecombe, in Somersetshire, has in its church a pre-Reformation chalice and paten. The chalice is very beautiful in its proportions, and has served as a model for many of those produced in modern times. It stands nearly six inches high. The bowl at the lower part is broad, with the sides conical. The hexagonal stem is divided into two parts by the knop, which is an excellent piece of work. At the projection of each of the arms, forming this member, is a leopard's head, the spaces between being ornamented with pierced work. The base is divided into six compartments, and in one of these is an engraved plate, upon which traces of enamel are still visible, the subject being that of the crucifixion. We owe our knowledge of this chalice and paten to Mr. Octavius Morgan. They are of great interest, not only on account of their beauty, but also from their antiquity, for they are almost the oldest examples of hall-marked English plate known.

It was in the year 1327 that the workers in the precious metals had granted them their first charter of incorporation, and in 1462 they received a third charter. The powers thus granted to the Goldsmiths' Company authorised them to inspect and stamp all gold and silver work produced in this country.

The Romanesque style took deeper root in Germany than in any other country of Europe, for we find that the Germans continued to produce work in that style longer than any of the other nations. But, when the older forms gave way to the newer ones of Gothic art, a very beautiful style was developed, which was most perfect, during the thirteenth century. One of the best specimens of this period is the shrine of the Great Relics, in the treasury at Aix-la-Chapelle. Its general form retains the old outline, but we see a great difference in the character of the ornamentation. The foliage upon the ridge of the pointed roof is most beautiful in design and execution.

Another specimen, dating from the early part of the thirteenth century, is the shrine of the Three Kings, at Cologne; in this there are more traces of the Romanesque style than in the example before mentioned. As the century grew older, these large objects became more scarce, and in their place a reliquary was made to contain only a part of the departed saint, and its form partook of the shape of the member which it contained. The next change in German art was commenced by the artists of Augsburg and Nuremberg, and, although it lacked much of the grace and refinement of the previous period, it was a style well adapted for the production of works in the precious metals.

The condition of Italy, at the beginning of the thirteenth century, was particularly favourable to the cultivation and development of the fine arts. Comparative peace was now established between the many small but wealthy States, into which this kingdom was then divided. At the head of each was an independent prince, and, as these rulers had no longer to vie with one another, as to who should be chief in battle, each strove for the State he governed to produce the finest works of art. The silversmith's art was in especial demand, it being held in greater estimation in Italy than in any other part of Europe, thus gaining for those who produced such work a higher social position, and accounting in a great measure for the rapid improvement that was now made in this artistic land.

At first the workers in silver were pupils of sculptors. Of them they learnt design and composition, but many of the apprentices soon excelled their masters, and a few years later we find that most of the great sculptors commenced their career in the workshops of a silversmith. Thus, again, the arts of sculpture and silver-working are brought together.

It was only during the thirteenth century that Gothic art held its sway in Italy, but during that time many great works were created. It will be impossible to give more than a rapid glance at this bright epoch in the history of the silversmith's art. As an example of the universal excellence of the work produced in Italy, I cannot do better than describe the chalice of this period. The bowl is most elegant in shape, the sides forming a graceful curve; round the lower part is often a little ornament in enamel. The knop, although an important part of the whole, is subordinate to the bowl and base, and was treated accordingly. The work upon it was generally in enamel, each colour being contained in a simple, but effective form. The stem is hexagonal, and is either decorated with a pattern in niello or enamel, or divided into little compartments with a deep edge, which produces effect by its shadow. The base is the member

which gave the artist the greatest scope for displaying his skill, and he took advantage of it to the utmost. It was usually divided into six or eight lobes, and upon these were represented various subjects in enamel or niello, and although the figures were so small, they were admirably composed and drawn, the border of each division being richly ornamented with a minute pattern, and the part of the base between that upon which the subjects were executed, being covered with a beautiful design in low relief.

The Church now had command of enormous revenues, and it was in costly metal work that the best means were found of investing its surplus funds. This accounts for the numerous and costly altar frontals which were made during the Middle Ages for the cathedrals of Italy. Upon them the greatest artists worked, and they are worthy illustrations of the wonderful skill of the Italian silversmiths.

The fifteenth century in Italy is chiefly remarkable for the works in bronze that were then created. It is at once noticeable to every student of art history that gold first claims the attention of a nation when in the infancy of art. Silver is next used as a medium, in which to express their ideas of beauty. When their art is fully developed, the precious metals are, of course, still used in their proper sphere; but we also find that the baser metals, and especially bronze, are much employed, as in that material the artist can carry out ideas that would be impossible in the more costly metals. Now, instead of town striving against town, as to which should possess the most massive object in gold or silver, we find one endeavouring to outbid the other, to secure the services of the most skilful artist of the day to execute, perhaps, some small, but perfect piece of work.

From the middle of the thirteenth century to the termination of the fifteenth, the metal work created by the Italian artists was of the greatest beauty; the forms were then both pure and correct, and it was the study of ancient art that brought about this splendid result. The style of these two centuries in Italy is one peculiar to herself, and of which she may indeed be proud. Although it was, in a certain sense, a revival of the old traditions, it was to the sixteenth century that the term of the "Century of the Renaissance" has been given.

The sixteenth century was, above all others, a time when classical subjects were most produced, the silversmiths being among the first to conform to the popular taste. Indeed, the style now practised was well suited to the commoner objects executed in gold or silver, but it is doubtful if the grandeur of the two preceding centuries could be attained in their larger and more ambitious works.

One great reason why the work of the latter part of this century did not reach the high standard of the sixteenth is to be found in the fact that the artist and the workman ceased to be one and the same individual. The designer was now a person in a higher social position than the plebeian artisan who executed his thoughts. Here, then, was the beginning of this fatal breach, which has done more injury, and more to prevent future progress, than all else to this noble branch of the industrial arts.

But, just before this fatal change took place, there lived an artist, who seemed to unite in himself the genius that usually falls to the share of a generation of artists.

Benvenuto Cellini is the artist of all others who represents the silversmiths of the revival, as Michael Angelo and Raphael represent the painters and sculptors. He was born at Florence in the year 1500, and at the age of thirteen was placed in the workshop of Michael Agnelo. The first work of which he speaks in his memoirs is a silver buckle; upon it were represented in low relief cupids and grotesque heads, intermingled with foliage. When nineteen years of age, he went to Rome, and, during the two years he resided in that city, devoted himself principally to the study of ancient examples. He then visited various places, and amongst others his native town; but in 1523 a quarrel obliged him to quit Florence, and he again returned to Rome, where he remained until 1537, and it was at this time that he gained much of his renown. In 1540, Cellini paid his second visit to Paris, and remained five years at the French Court, during which time he executed many important works for Francis I.

Had we not the short account by Vasari of this remarkable man, and if there were only his own autobiography by which to judge of his merit as an artist, we might well have doubted if the vast reputation of this artist, workman, and author, was not gained more by his pen than by works of his creation. Let us, however, form our opinion of him as a citizen, from the well-known memoirs in which he gives such a graphic description of his various doings; and, as an artist, from what another says of his work; and before Cellini is accused of being a man of the worst character, we must consider the state of society at the time in which he lived. All the dangerous vices of a highly cultivated people were allowed to flourish without any restraint whatever; but, notwithstanding this, Cellini has painted himself in no enviable light. As an artist, however, he must have had the highest position, and his works were, without doubt, held in the greatest estimation.

The Italian biographer, in his "Lives of Painters and Sculptors," speaks of him in the following glowing terms:—"Benvenuto Cellini, citizen of Florence, at present a sculptor, in his youth cultivated the goldsmith's business, and had no equal in that branch for many years, nor in making fine figures of alto and basso-relievo, and every other work belonging to that ingenious art."

Before we take leave of the great Florentine artist, I must mention that he, like Theophilus, wrote a treatise on the silversmith's art. In this he describes the method of making jewellery, composed of gems, the composition and application of niello, the art of filagree, enamelling, jewellery properly so-called, that is the art of forming, from sheet gold or silver, the little figures with which he so richly decorated his work. He also speaks of the engraving of coins; but the most interesting portion is that wherein he explains the process of making gold and silver vases, and silver statues of even the size of life. One method of ornamentation much used during the sixteenth century, and which received so much attention from Cellini, is damascening, or the art of forming designs in gold or silver, on iron, bronze, or other hard metal. This is one of the most interesting processes used in the decoration of metal work, and I am able to

illustrate the method of producing this work by two specimens, the one in an incomplete stage, and the other the same design finished.

Spain was one of the first countries to follow the great example set by Italy. This may be explained by the frequent intercourse then existing between these two nations, and also through the unsettled state of their art after the evacuation of the country by the Moors. It was now that the discovery of the New World poured into Spain a hitherto unheard of supply of the precious metals, especially of silver; and, as one would suppose of a people so devoted to their religion, large quantities of these riches were made into church plate, and given to various cathedrals and churches throughout the land.

Perhaps, after Italy, in no other country of Europe flourished so beautiful and characteristic a style as that which was developed by the Germans during the sixteenth century; and, what adds an additional interest to it is, that it is a national art, a creation of their own, and not, as was the case with the other countries, a direct copy of the Italian Renaissance. At the commencement of the century, the traditions of Gothic art were much adhered to, the constructional lines of that style being generally used, but they were greatly modified, and afterwards almost entirely superseded by the vegetable forms, which, at first, were only entwined round them, but, by degrees, these ornamental branches formed the essential part of the design in much of their silver work. This peculiar characteristic was impressed upon their art by an eminent group of artists, at the head of whom was Albert Durer, and the style of which I speak will at once be detected in many of his etchings. The work that was now produced in Germany does not, of course, bear comparison with the masterpieces of the Italian silversmiths, but this German art has a grandeur of its own, which can only be obtained by earnest endeavour in an original style. This is not the time at which to expect great works to be created for religious use, especially by the country which gave birth to the Reformation, but at Augsburg and Nuremberg were manufactured every class of secular metal work in the greatest profusion. The artists of Nuremberg preserved in their work that German feeling of which I have spoken longer than their brethren of Augsburg, but in the latter part of the century, nearly all the silver work, especially that composed of figures and ornament in low relief, closely resembles that of Italy. In the form of their vases, they still preserve their originality; and the arabesques with which these object were often decorated, are beautiful in design, and exquisite in workmanship.

In France, it was during the reign of Francis I. that this style reached the height of its power. The king, having seen the productions of Italian art, determined that his own countrymen should have the benefit and example of the greatest masters. Together with eminent painters and sculptors, Benvenuto Cellini was invited to the French Court, and by these artists was the cinquecento introduced and developed in France.

We have now reached a period in the history of the silversmith's art at which I desire to draw particular attention to England. Not that the work produced in this country during the fifteenth century is worthy to be classed before that of the other nations of Europe, but because the art of this land is naturally of the greatest interest to us; and, moreover, I do not think we should be satisfied with the state of this industry in England at the present moment; and if my humble efforts to-night are to lead to any practical result, it will be necessary to follow more closely the history of this art in our own country, and to devote but few words to the silver work of other nations.

It is sad to find that the records we have of silver plate in England during the sixteenth century relate more to destruction than creation. But for the wholesale spoliation which now befel the goods of the Church, what art treasures would have yet remained to us!

It is usual to credit Henry VIII. with having effected the whole of the ruin which now befel ecclesiastical property, but in the reign of his son, Edward VI., many of the parish churches retained their original plate. It was not, indeed, until Queen Elizabeth allowed all the churches to be sacked of the last remnants of these "monuments of superstition," that almost everything was swept away. Before this, however, a gradual devastation had been steadily going on, for in the last year of the reign of Edward VI., by order of the Commissioners, nearly all was seized but a few chalices, the number and size of those being left according to the size of the congregation. But even these could not long be spared, for directly after came injunctions from the king that all "monuments of feigned miracles" were to be ruthlessly extinguished. The chalice in which the mass had been celebrated came under this ban, and but few escaped its dire influence.

In the churchwardens' accounts for the year 1552, in very many parishes, will be found an entry relating to the exchange of the chalice and paten for a communion cup. But these new objects had but a short life, as upon the accession of Mary in 1553, they were not, of course, considered fit for the restored ritual of the Church of Rome. The respite granted to religious art during the short reign of Queen Mary was, however, of no avail, as her half-sister, Elizabeth, was a most inveterate enemy to all Popish belongings.

In 1659, at the visitation of Matthew Parker, he inquires if within the diocese of Canterbury, "they do minister in any prophane cuppes, bowles dishes, or chalices hitherto used at masse, or els in a decent communion cuppe provided and kept for the same purpose only." The consequence of this untiring search is the almost entire destruction of pre-Reformation ecclesiastical silver-work.

"The fair and comely communion cup of silver, and a cover of silver for the same, which may also serve for the ministration of the communion bread," which the Commissioners of Queen Elizabeth directed to be used in every parish in England, is too well known to need much description. Numerous examples are to be met with all over England. It is very remarkable what exact uniformity of design was always maintained in these Elizabethan chalices. The bowl is always of the same elongated form, somewhat resembling an inverted bell. As the feeling became less Popish, so the bowl of the chalice was made to turn outwards at the edge, until at length it was almost the shape of a goblet. Round it is an engraved band, composed of two double lines,

which interlace in precisely the same way in nearly every example, the space between being filled by a running pattern composed of conventional foliage. The stem is still divided into two parts by the knop, which is, however, much smaller. The foot is now always round, and some of its mouldings are worked into small flutings. It will be seen that it is an object to which the term cup is more applicable than that of chalice, especially as no sacred monogram, or other emblem to mark their religious use, is often found forming part of the ornamentation of the communion cup.

The similarity in shape and design of these vessels seems to point to some regulation pattern being at one time ordered, but no such injunction has yet been discovered. These chalices were mostly made in London, Norwich, York, and Exeter, a very slight deviation in the shape of the bowl being observable in those made in the various localities. The Norwich chalices are noted for the greatest divergence from the usual pattern. The silversmiths of this city made the bowl wider and with straighter sides than is found elsewhere. This form of communion cup continued in favour until about the middle of the next century, but after 1600 the type degenerates.

Flagons which came into use during the reign of Queen Elizabeth, and took the place of the cruets of former days, became now a necessity of the time from the increased use of wine at the communion. Some of these were of great size; two in Frome Church, lately turned into other church plate, held nearly a gallon each. These were long straight-sided vessels, with good bold bases and well-shaped covers. The average quantity of wine used at this church in 1575, for the 10 communions in one year, for a population of 5,000, was fully "ten quarts of sacke" upon each occasion!

When we turn to secular plate, we find that the hanap was the object upon which the silversmith could best display his artistic power and skill of execution. There is a beautiful specimen at the Mercers'-hall, which illustrates the style at beginning of the century. It is also interesting as being the earliest known that is hall-marked. The Elizabethan hanap, although not so well known as the chalice of the same date, is still to be found in the cabinet of many collectors of old English plate, the style of ornamentation being very similar to that upon the chalice.

During this century, the salt-cellar was made in various shapes. The first type was that known as the hour-glass salt. About the middle of the century, it became an object of more beauty and importance, being generally square and highly enriched with *repoussé* and engraved work. At the end of the century, we come to the circular or bell-shaped salts. These were made in three tiers, the two lower compartments holding the salt and the upper forming a pepper-castor. Although not deficient in ornamental effect, they cannot be favourably compared to the types before mentioned.

The rose-water dish gave the silversmith every scope for displaying his power of design, and, from remaining examples, we see that of this, by many, every advantage was taken. This is the case in a beautiful specimen belonging to the Merchant Taylors' Company. In the centre is a coat of arms in high relief; round this are six panels, containing, alternately, dolphins and conventional vegetable forms, all executed in *repoussé* work. The mazer bowls also received enrichment from the silversmith, the silver rim placed round these wooden bowls to increase their depth being often highly decorated.

It was during this century that apostles' spoons came into such general use, they being the fashionable christening present of the period, the wealthy giving a complete set, and the poor a single spoon, having upon it the patron saint of the donor, or the saint in whose honour the child is named. During the time Holbein was Court painter in this country, he found leisure to make some beautiful drawings for gold and silver work; but, although these drawings are most exquisite designs for silver objects, none of the English silversmiths seem to have been sufficiently skilful to follow the example he set them.

The most important productions of the silversmiths in England during the seventeenth century, were the large drinking vessels, known as grace cups, or loving cups. These are all very much alike in style, generally being composed of a bowl covered with ornament in low relief, surmounted by a cover of open or pierced work, and in form somewhat resembling a steeple; the stem is often composed of acanthus leaves, with baluster-shaped mouldings, the foot being round, and some of its members ornamented with flutings; others with a small running pattern. Many of the City companies still possess examples of these grace cups, and they often bear the name of the warden who presented them to the company.

Repoussé work in high relief seems not to have come much into fashion before the time of Charles II., but after his time, the large tankards, and particularly caudle cups and trays, were covered with bold *repoussé* work, to the exclusion of the former style of James and Elizabeth. During this century a large amount of engraved ornament was applied to smaller objects, especially to watch cases.

As the use of wine became more general in the Church of England, so the chalice increased in size. In many places we find a kind of grace cup, or hanap, amongst the Church plate, probably the gift of some rich parishioner. These large cups, with covers, were silver gilt, with ornamental open work forming the stems. These vessels, which have, as yet, received but little attention, considering their interest and beauty, are mostly of the first quarter of the seventeenth century. A very fine one is to be seen at Yarlington, in Somersetshire, and another at Horsington, in the same county. The height of the Horsington cup is 20 inches, and the bowl is five inches in diameter, this being about the usual size for these vessels. The ornamentation on the cover is similar to that in the Yarlington cup, showing a common type. These hanaps were probably used as a supplemental chalice, when the ordinary vessel would not hold enough wine. No doubt many of these interesting specimens would be found, were our country churches searched.

In the reign of Charles I. was continued, and probably for the last time practised, a custom most beneficial to this industry. On every New Year's Day each noble, each noble lady, and every member of the Royal household, down to the knight, was accustomed to offer the king a present, according to their station. At this time, in fact, all the

Royal servants of gentleman's rank gave a New Year's gift, in proportion to the rank they held, generally doing so in kind; that from the nobles, however, being in money. Thus Dr. Harvey (the discoverer of the circulation of the blood) gives a box of marmalade, and he has sent him in return a present of 24 ounces of plate, each person receiving as an acknowledgement some work in silver, according to the largeness of their offering. In 1640, forty-two persons, members of the household, had presents in silver. The sergeant of the scullery gives a basket of coals, and receives 10 ounces of plate; and one giving a red Turkey carpet received a present weighing 300 ounces. The gift from the king was usually half the value of the present he had received from his subject—the honour of giving an offering to so exalted a personage having to compensate the donor for the other half.

By means of this custom, a considerable number of works in silver were annually scattered over the country. In the manuscripts of Sir Henry Mildmay, the keeper of the jewels for Charles I., is recorded the weight of every present given by the king during his tenure of office. Amongst these same records, there is one dated September 23rd, 1647, which curiously illustrates the mode of living at that time, being the order from the Committee of Revenue to Sir Henry Mildmay, to send the following articles for the king's use, when a prisoner at Hampton-court :—One gilt salt, "Tobias"; 12 gilt trencher plates, crowned E; two knives; one fork, gilt; two saucers, white; two spoons, gilt. Thus we see at this time even the king had only one fork allowed him, although 12 silver plates were deemed necessary.

The civil war of this period caused great destruction to domestic silver work. The Reformation had swept the Church plate away, and now to supply means with which to carry on the determined struggle in this disastrous war, an enormous quantity of plate used in the household was consigned to the crucible.

We now come to the reign of Queen Anne, sometimes called, in England, "the Augustan age." Certainly, during her reign, great excellence was reached in this art, whether as regards her coinage, or silver work in general, for all purposes but that of the Church. At this period, the chief means of decoration were chasing, fluting, and ribbing, with a large use of the acanthus leaf.

The introduction of tea led to a great development of silversmiths' work. The greater number of the tea-caddies (lately so much sought after) are mostly of this date. Cream jugs, tea-pots, tea-urns, and tea-kettles naturally followed the demand for the novelty, and led to a considerable manufacture of new designs.

But, although domestic silver-work made great progress in style, the Church plate became more and more debased, and, by 1720, the chalice had lost all beauty, and somewhat resembled a large wine-glass.

Most of the work of this century was done by men of small means, who had usually two or three workmen only. It was not until quite the end of this period that large factories were formed for the production of silverwork. Amongst the first of these was that of Rundell and Bridge, who employed Flaxman to design for them.

Few industries have had to struggle through more difficulties, restrictions, and penalties than that of the silversmith; difficulties beginning so far back that their origin is obscure, but they were much felt in the fifteenth century, still more so in the sixteenth, when it was forbidden to work in a back street. In the seventeenth and eighteenth centuries the law was again more strict, making the crime of forging a die-mark to be punishable by hanging, and forbidding any exportation. With such numerous hindrances, it is wondrous how the silversmith's art has flourished at all in this country, and produced such works as it has. If, with all these restrictions, so much has been accomplished, how much more might have been done had the trade been as free as other art industries. Of one thing we may be certain, that, whatever preservation or value marks are to plate, the decadence of modern times commenced as soon as a tax was laid on silver-work. This had its beginning in the time of George I., with 6d. an ounce, and went on—with a short interval between 1758 and 1784—increasing up to 1815, since which year it has been 1s. 6d., with also a tax on every one dealing in silver; so that, in fact, there is a double tax.

I will now ask for your patience but a few moments, while I briefly state the present condition of this art. In Germany, some very fair work is produced, but chiefly of a heavy character, chased in the Renaissance or classical style. Italy and Spain may be classed together, each being clever in small objects, and the latter country is particularly famous for her damascened productions. France is deserving of high praise for her nineteenth century plate; the figures with which French artists enrich their work being admirably designed and modelled. America is at present making the most rapid advancement in the silversmith's art; from her we have much to learn, if not to fear.

I have spoken of the excellence obtained by the Greek artists, and of the perfection of the silversmith's art in Italy, and also of our own success at the time of Queen Anne, but it is not so easy to speak of our present or future greatness in this art.

There may be many opinions as to the reason of this decadence, but there can be no difference as to a fact, which all must admit, that since the art has been subjected to the trammels of the Excise, it has degenerated. In mentioning this, it is not to tie anyone to the opinion that it is through this connection of a tax with labour, but simply to note a concurrence; and if it can be shown that other nations are making progress, and have not this tax to contend with, and that this art has been degenerating in England ever since we have had a tax, the question may then be fairly left for everyone to answer according to the bias of his own mind. I may be permitted to remark that the bias of my own mind is very distinct upon this point. But there are so many conflicting influences, as to make it difficult to get at the real truth of the case. Thus, I know of one silversmith who wished the tax to be twice as much as it is now, and that simply because it might prevent any fresh opponent from having an establishment near him. Now, this man stated exactly the usual protectionist feeling against all rivalry; but the spirit of the age is for open competition, as no art, no profession, nor

any industry can ever become general if surrounded with restrictions and difficulties. It so happens that the work of the silversmith—the industry always placed before every other art-industry—is the only one now subjected to the control of the tax officer, and to the penalties and endless fines which, in some form or another, harass the worker in the precious metals. That they are serious impediments to art progress is my earnest conviction. We are all acquainted with the liberal professions and the liberal arts, but we hear nothing about the liberal trades. A man is proud to be thought a doctor, a lawyer, a clergyman, or a painter, and why should he not be proud to be an art silversmith? Without doubt, the question will soon have to be solved, how are we to rectify this error? The doctor has his medical school and hospital, the clergyman his college, and the painter his academy, in which to ensure a careful training, but where is the silversmith to learn his liberal art?

In France, or Germany, the master is often artist, workman, manufacturer, and merchant combined; technical education being more common in those countries than with us. But in England the master is generally a man who does nothing himself but receive the orders given to him; he hands these on to his foreman, who distributes the work amongst the workmen. Naturally, individual skill and merit occasionally comes to the front, and from our division of labour great success has been obtained in various processes; but as to the certainty of a good result, who would think of apprenticing his son to a silversmith, if he had any other branch in life open to him? And thus, the result of our doings in modern times have been, that during the reign of George IV. we had the "king's pattern" epoch, and that now we have come to the "fiddle pattern" era, and this we can only manufacture in three or four places in England, whereas a steam-engine can be made in hundreds of towns and villages of this kingdom.

Now, this state of things can, as far as I am able to see, be only obviated by, firstly, the repeal of the duty, and this is irrespective of the question of hall-marking. Hall-marking existed long before the duty, and there is no reason why it should not continue long after the tax has been removed, if it should be thought advisable. My hope is that, at no very distant time, a thorough reform may be effected. I ask for nothing less than perfect freedom. I would then suggest that a great change should be attempted in the teaching of apprentices to this art, it being now too often learnt by the rule of thumb.

We have, as I pointed out, schools for instruction in the liberal professions, and if this art is to be great in England, we must have a grand central school, in which a thorough education can be given to the silversmith—a veritable college for metallic art. With such a college in which to train those who wish to follow this beautiful art, we may reasonably hope that the silversmith's work of the Victorian age would soon be found worthy to rank with the noblest works of ancient Greece and Italy.

DISCUSSION.

Mr. William Botly thought Mr. Singer's remarks ought to convey a lesson to the guilds, and to society generally. It was much to be regretted that parents should shrink from apprenticing their sons to any trade, and specially to such a one as this, which ministered so much to the grace, beauty, and refinement of life. The duty of 1s. 6d. an ounce, he thought, all would condemn; and seeing the abundant supplies of this beautiful metal which had recently been forthcoming, it seemed to him that now would be a very appropriate time for its repeal; when every trade in the country, and particularly the silversmiths, wanted a little fillip. He had lately had the privilege of seeing one of the most elegant chalices, not only in England, but in Europe, which was presented to the Bishop of Inverness, on the occasion of his golden wedding. It was set with jaspers, emeralds, and other precious stones, and formed a most beautiful object. Considering the beautiful works of art which had been seen in the various exhibitions, in particular the splendid service of plate presented to the Hotel de Ville of Paris, at a cost of 1,200,000 francs, which was, unfortunately, destroyed at the time of the Commune, they must all admire the art and beauty which this interesting industry had produced, and hope that it would become more flourishing.

Mr. Fosketh agreed that it would be highly desirable to take the duty off silver, but thought it would be necessary to retain the hall-mark, so that the public might have some security as to what they got for their money. With regard to artistic quality in the work, he had remarked that, in the case of iron, bronze, or brass work, especially for ecclesiastical purposes, you could get what price you liked almost for good work; but in the case of silver, the buyer did not look so much at the work, but inquired how many ounces he was going to have. If you wanted good work, you must be willing to pay for it. Metal of any kind you could buy by the ounce, the pound, or the ton, according to the quantity you wanted, but art workmanship came under a different category altogether.

Mr. M. S. S. Dipnall thought the lecturer had omitted one very important factor in the question, viz., the introduction of electro-plate, since which, and the easy multiplication of patterns by means of the swage, ordinary families were able to deck their tables with all the elegance and apparent riches which plate used to give to the tables only of the noble and wealthy. The use of electro-plate had hence largely replaced that of silver, and to some extent also the employment of art, because copies were multiplied, instead of the artist turning out each article by his own hand and skill, as they had lately heard was the case with the Lambeth pottery. If he ordered twenty cups from Lambeth, they would all slightly differ from each other, and each would have an individual beauty of its own; and the same result would follow if he ordered twenty cups of a silversmith of a different pattern; but it would not be so with a set produced mechanically from one model. This, therefore, formed an important factor in the decadence of the art. At the same time, it had added immensely to the elegance of the tables, both of the middle classes and the more wealthy. The best qualities from the first makers could not be distinguished from silver by any ordinary inspection. Another matter which had not been touched upon was that of medals, which was of great interest, and many of the specimens both here and in Paris were very beautiful.

Mr. Watherston said he had listened with melancholy interest while the lecturer held up this trade, and quite rightly so, as an awful example of the disadvantage of protection. The trade suffered in a variety of ways. In the first place, it suffered from an excise, one of those terrible inflictions of Pitt, which extended and increased as wars went on, until it became 33½ per cent. of the value of the raw material. Next, it suffered from a system of hall-marking, which was supposed by many members of the trade to be a great advantage, whereas it was originally instituted for the very worst of trade

union purposes, to prevent competition in the trade, and instead of being an advantage, many intelligent men were convinced that it was quite the reverse. Again, it had suffered from its connection with a City company, which he held to be the very worst thing which could befall any trade. Happily they had lately had a Parliamentary committee, by which the duty had been condemned unanimously; and though, by a majority of one, the committee recommended the system of hall-marking to be continued, the minority consisted of Mr. Goschen, Mr. Muntz, and Mr. Thomson Hankey, three first-class men, so that he hoped that in a few years longer that gross absurdity also would be removed. The tax was unjust, because no other trade was now taxed, and because the silversmith had to compete with the electro-plater, who paid no duty, and who was permitted to use marks so closely resembling those on silver, that at arm's-length you could not tell them apart. His father told him that on one occasion he went to Goldsmiths'-hall, and laid on the table some spoons, partly electro-plate, and partly real silver, and not one member of the Court could tell which was which. The year before last he tried the same experiment on the President of the Board of Trade and fourteen Members of Parliament, and they were all equally at fault. To show how the trade was declining, he might mention that between 1855 and 1859, the weight on which duty was paid dropped from 994,000 ounces to 801,000; and twenty years later, with all the development of the wealth and trade of the country, there was again a decrease in five years from 880,000 ounces in 1875, to 740,000 ounces in 1879. There was thus a decrease of 250,000 ounces in a period of twenty years, during which there had been the most wonderful prosperity in the country. This represented a wholesale trade of £125,000 a year, which, of course, meant a large number of workmen kept out of the trade. To revive the trade, four things were necessary: first, to remove the duty; secondly, to substitute a system of voluntary for compulsory hall-marking; thirdly, to get rid of the Goldsmiths' Company; and, lastly, to establish a system of technical education. Inasmuch as the Goldsmiths' Company's funds were the absolute property of the goldsmiths of England, every fraction of the money having been left for the benefit of the trade, he maintained that the company ought to provide a system of technical education. The apprenticeship system was gone, and it was the duty of the company to set on foot something which should take its place. In his opinion, the right thing to do would be to establish scholarships for boys leaving the primary schools at thirteen, and to found a school, similar to that at Besançon and other places in France, where the boys should continue their literary education, and at the same time be instructed in the trade; a museum and library should also be included. By the time they had reached the age of sixteen, such boys would be eagerly sought after by manufacturers, who were now, owing to the decay of the apprenticeship system, hardly able to bring up learners in their own workshops.

Mr. F. Bramwell said the writer of the paper had very properly kept the questions of the duty and of the hall-marking distinct. No doubt a duty of 1s. 6d. an ounce, on a material only worth 4s. 6d., was enormous, and all would agree that, so soon as it could be removed, it ought to be; but at present it produced about $\frac{1}{1000}$ of the total revenue, and therefore, probably, the Chancellor of the Exchequer would find some difficulty in its abrogation. The author lamented the restrictions under which the members of this trade were placed, but it seemed going rather too far to include amongst them the enactment that forgers of marks should be hanged, for honest men would not find that provision at all irksome. As to the question of hall-marking, the reader of the paper very fairly said that it had existed for a very long time, including the period of Queen Anne, which he put as the time of the greatest excellence of manufacture; and the Parliamentary Committee, in their report of last year, said they should pause a long time before doing away with that which had existed for 500 years. But they did not give a reason, which they might have given, viz., the need of combating the terrible tendency to adulteration in all cases where it could be carried out with impunity and with profit. Special Acts of Parliament had had to be passed to check this tendency in the case of food and drugs, and if there were a necessity to establish such machinery in the case of food and medicines, surely the machinery already in existence with regard to silver plate, when the temptation to adulteration was far greater, should be allowed to remain. A previous speaker, for some reason or other, thought it very undesirable that this inspection of quality should be made by the Goldsmiths' Company, but that company had authority only existing in London, and there were six other places in the country where the hall-mark could also be given, and he had not heard, and indeed he should be surprised to hear, that these six offices, or any one of them, did its work in a manner superior to the Goldsmiths' Company. The Goldsmiths' Company, with regard to the assay of plate, were nothing but the instrument of the Government for the purpose of collecting the duty; they did not make one shilling out of it beyond the expenses of the office. The same speaker was very jocular about the members of the Court being unable to distinguish electro-plate from silver; he also said that fourteen M.P.'s were equally foolish; but he (Mr. Bramwell) thought the very object of an assay was to ascertain, by a chemical experiment, what was the nature of a materia which you could not tell by the eye, and, therefore, it did not seem so very absurd that those who were not then making an assay, but were merely looking at the thing, could not tell whether it was silver all through, or whether it were only coated. Some men could see into a milestone, and it would require optics equally good to see whether that which lay below a surface of silver was real silver or something else. Then there was a doleful statement as to the decadence of the trade, as shown by the amount upon which duty was paid; but, upon that point, he should like to read one paragraph from the report of the Parliamentary Committee, which attributed this, not to a falling off in the trade, but in part to the durability of plate, and in the main to the introduction of electro-plate. So far from there having been a falling off, the trade in plate seemed to have increased largely. This was shown by the number of persons who took out licenses as dealers, there being now 2½ times as many as in 1846. It might be said, why not let manufacturers do what they liked, and let the buyer beware? That plan was tried, some years ago, with tobacco, but the increase of adulteration became so enormous, that the Legislature had to step in and stop it. This showed how great was the temptation to fraud where fraud was profitable. One speaker had condemned nine carat gold; this standard was forced upon the trade by the influence of a man in power, when the Act was passed a few years since; but articles of this standard were hardly made at all in London, or anywhere else, except in one town, and not there to any very great extent; and the committee recommended that this debased standard should be abolished. Further, with respect to fraud in silver ware, Queen Anne plate was much admired at the present day, as was also Queen Anne furniture—by the way, he was not aware that the decadence in furniture-making was owing to any duty on wood—and many ingenious makers imitated this Queen Anne plate. Purchasers, however, preferred the real thing to that which looked liked it, and consequently some makers cut the hall-mark from a genuine article of small value, and inserted it in their new work, so as to fetch several shillings per ounce more money. The Goldsmiths' Company endeavoured to repress this and other frauds to the best of their ability, but without much success at first, because, though the former Act of Parliament

made it penal to knowingly possess such articles, juries were not satisfied that guilty knowledge was absolutely proved, and therefore they could not convict. Then there was an Act passed, imposing a fine for the possession of a fraudulent article, unless the dealer revealed the name of the person from whom he got it. Two or three years ago, a person keeping a respectable-looking shop in a principal thoroughfare was proceeded against, two pieces of plate being found in his shop window, which had old marks fraudulently inserted. He said he was very sorry; he knew nothing about it. As he paid the penalty, the Act did not allow publicity. It subsequently appeared that so far from his knowing nothing about it, the articles had been made to his order, and that he had supplied old marks to be worked in. After this it came out that the same workman, for many years, had been making this kind of article for the same tradesman. There was no difficulty then in proving the guilty knowledge; the tradesman was tried at the Old Bailey, and was now upon the treadmill. This showed how frauds were effected, even with all the precautions taken; and therefore, though he (Mr. Bramwell) desired that every trade should be free from all trammels, to his mind the having plate examined by competent persons and certified, was for the good of the community, as well as for the good of all honest traders themselves. Nor was it paid for at too high a price by having to put up with what was not a real trammel, but a sentimental one.

Admiral Selwyn said he had been working recently in the silver mines of Nevada and Utah, and in doing so had discovered, or perhaps re-discovered, a process by which more silver could be obtained from the ore, which would, of course, tend to reduce the price. More silver now could be got out of any ore than the fire assay showed, because that always sent some up the chimney, whereas, by the humid process, the whole of the silver could be obtained. The result had been to reduce the price from 5s. to 4s. 2d., and it would probably go much lower. Although it was perfectly true that by the swage and other mechanical applications you could imitate the beautiful chiselling of hand-work, the result was never satisfactory to the eye; but it so happened that, during some investigations into metallic cartridges, he discovered, and pointed out to Messrs. Elkington, that by a gas hammer inside a plate of silver, you could produce the finest scratch or the deepest incision exactly like the original. If you enclose a plate of silver between two others inside a sphere, and then exploded a small quantity of air and common gas, you would get a perfect copy of the work, which no one could distinguish from the original. Some people said this kind of thing would vulgarise works of art; but what had vulgarisation done for all the arts, for instance, in the case of photography? Simply put into the possession of the whole world that which was formerly the exclusive property of the few; and, in doing so, they had introduced to the million that great principle which the Romans always recognised, that the study of the arts faithfully had the power of humanising the human race. It was not to be said that reproduction in a perfect way was open to the same objections as reproduction in a vulgar way. If he could not have a perfect copy of a statue, he would not have any at all, but if a perfect copy were produced, two persons were gratified instead of one. The great question was now being mooted in Europe, would you give the person who created a new art or industry the opportunity of assuring a capitalist that he might safely put his money into it; if so, there would be no limit to the production of this country, and to its power of paying for its food. He referred to the great principle of an international Patent-law, which would give security to the capitalist, without which it would be vain for us to attempt to compete with America, where this security was afforded.

Mr. Chapman said the reader of the paper had remarked that the designer was now a person of a higher social position than the workman, and that, no doubt, was the cause of the bad designs the silversmith was often called upon to execute. He would refer to the celebrated Wellington shield, designed by Stothard; but Messrs. Green and Ward said they had no workmen who could execute it. Mr. Stothard was asked what he could do, and he said he thought he could model it himself. Had electrotyping then been in vogue, they would have had Stothard's work carried out in silver, and it could have been multiplied, as the celebrated Cellini shield had been. There was no doubt the introduction of electro-plate had depressed the trade in silver, but he doubted if it had depressed workmanship; because, under this process, it was possible to introduce other styles of ornament to those possible in old-fashioned plated goods, and thus the public taste had been improved. There were more men working on ornamental work now than formerly. No allusion had been made to the introduction of *niello*, which was very interesting, as the wiping off the impression from the silver led to the invention of printing. He might say that he had been following the directions of Theophilus to some extent, and had found them answer. There could be no question that the sooner the duty was taken off silver the better, because the lower the price of any article, the greater the consumption.

The Chairman, in moving a vote of thanks to Mr. Singer, said he believed that both the duty and the compulsory hall-marking was injurious to the trade, though he agreed with Mr. Bramwell that there would be a large amount of falsification. Still he could not see that the argument, from the case of food and drugs, applied to that of silver plate. The one affected the health of the population, and the other did not. There was a tendency in all branches of manufacture to make things cheap, at the expense of quality, but the Legislature did not interfere to prevent the adulteration of cloth, or many other things in which it was to be feared honesty was not always observed. Voluntary hall-marking he believed would be a very good thing, and all honest tradesmen would avail themselves of it. The forger of a hall-mark must be punished like all other forgers; and that would give all necessary protection. He was glad to hear the suggestion about technical education, and also to find that the Goldsmiths' Company had already taken a step in this direction by offering prizes, and also a travelling scholarship. As soon as the Technical College was formed, which he hoped would soon be the case, this, in common with other trades, would receive a still further stimulus. He had lately seen some beautiful specimens of American manufacture, evidently the handwork of persons of considerable talent, and not manufactured by machinery In that country there was neither duty nor hall-marking.

The vote of thanks having been passed unanimously, the meeting adjourned.

MISCELLANEOUS.

LIST OF OFFICERS OF THE SOCIETY OF ARTS.

It has been thought that a complete list of the officers of the Society, from its first institution to the present time, is likely to be found useful, and the following list has, therefore, been prepared. A few words of explanation are needed in respect to some of the names. William Shipley was practically the founder of the Society, and he acted as Secretary and Registrar during the first year of its existence. In 1755, he restricted himself to the duties of the Registrar's office, and

George Box was appointed Secretary. In 1760, another change was made, when Dr. Peter Templeman was chosen Principal Secretary, and George Box became Assistant Secretary. From that time, the series of Secretaries was continued without any break; but there are one or two breaks in the list of Assistant Secretaries, owing to various changes in the office arrangements:—

Presidents.

Jacob Viscount Folkestone	1755—1761
Robert Lord Romney	1761—1794
Charles Duke of Norfolk, E.M.	1794—1816
H.R.H. the Duke of Sussex, K.G.	1816—1843
H.R.H. Albert Prince Consort, K.G.	1843—1861
William Tooke, F.R.S.	1862
H.R.H. the Prince of Wales, K.G.	1863—

Chairmen of Council.

George Bailey	1848
Edward Speer	1848—1849
Francis Fuller	1850
Henry Cole	1850—1851
W. W. Saunders, F.R.S.	1851
Henry Cole, C.B.	1852
Captain Owen, R.E.	1853
Harry Chester	1853
Viscount Ebrington, M.P.	1854
Rev. James Booth, LL.D., F.R.S.	1855
Colonel W. H. Sykes, M.P., F.R.S.	1856
C. Wentworth Dilke	1857—1858
Sir Thomas Phillips	1859—1862
William Hawes, F.G.S.	1863—1865
Sir Thomas Phillips	1866
William Hawes, F.G.S.	1867
Lord Henry G. Lennox, M.P.	1868—1871
Major-Gen. F. Eardley-Wilmot, R.A., F.R.S.	1872—1874
Lord Alfred Spencer Churchill	1875—1876
Major-Gen. F. C. Cotton, C.S.I.	1877
Lord Alfred Spencer Churchill	1878—

Secretaries.

William Shipley	1754
George Box	1755—1759
Peter Templeman, M.D.	1760—1769
Samuel More	1769—1799
Charles Taylor, M.D.	1800—1816
Arthur Aikin	1816—1839
W. A. Graham	1839—1842
Francis Whishaw	1843—1845
J. Scott Russell, F.R.S.	1845—1850
George Grove	1850—1852
Edward Solly, F.R.S.	1852—1853
Peter Le Neve Foster, M.A.	1853—1879
H. Trueman Wood, B.A.	1879—

Assistant Secretaries.

George Box	1760—1779
Richard Samuel	1779—1787
John Samuel	1787—1798
Thomas Taylor	1799—1805
Charles Combe	1806
Thomas Woodfall	1807—1842
S. T. Davenport	1848—1849
W. Ellis	1849—1850
James Forrest	1852—1856
Charles Critchett B.A.	1856—1869
H. Trueman Wood, B.A.	1876—1879
Henry B. Wheatley	1879—

Registrars, &c.

William Shipley	1754—1760
Edward Grant Tuckwell	1761—1766
William Bailey	1766—1773
Alexander Mabyn Bailey	1773—1779
George Cockings	1772—1802
Miss Ann Birch Cockings (Housekeeper and Registrar)	1802—1844
S. T. Davenport (Financial Officer)	1853—1875
Howard H. Room (Accountant)	1876—

CONFERENCE OF MUSEUM OFFICIALS.

The following letter, on a proposal for a Museum Conference, appeared in *Nature*, for March 11, 1880:—

"You did me the honour, about two years ago, of inserting an unsigned communication, pointing out the extreme desirability of a Conference of officials connected with museums and galleries of art throughout the country. At the time the subject received a good deal of attention from various quarters, and the numerous advantages which might be derived from such a meeting, commended the suggestion to all who wrote on the subject. No one, however, ventured to make a practical move in the matter at the time, and the subject consequently dropped.

"Further consideration and growing experience have deepened my conviction of the utility of the Conference scheme, and, as I have reason to believe, I am not singular in that experience, I desire now to see some effort made to bring the question to a practical issue. With this view, I shall be glad to co-operate with other museum officials who feel inclined to take part in the preliminary work of organising a Conference of those interested in museums and art-galleries. As to where, when, and how the Conference should be held, I do not wish to offer a single suggestion which might anticipate future consideration. Neither do I consider it necessary to occupy your space with any statement as to the great and manifold advantages which ought to accrue to our scattered exhibitional institutions by a union such as might be formed. These are surely too manifest to every individual who has to do with any museum, especially in the provinces.

"I hope this question will now be taken up heartily and energetically by all interested; and, while I would beg that you may give space for the suggestions which others may wish to make through the medium of *Nature*, I shall be glad to enter into correspondence with those who may address me privately.

"James Paton,
"Superintendent of Kelvin-grove Museum and
"the Corporation Galleries of Art, Glasgow."

INTERNATIONAL EDUCATIONAL CONGRESS.

At the meeting of the "Congrès International de l'Enseignement" to be held in the autumn, at Brussels, under the presidency of M. Van Humbeek, Minister of Public Instruction, the six questions which will be discussed in a general meeting of the sections are:—1. What is the aim to be pursued by the legislator in elaborating the programme of primary instruction? 2. Ought the programmes of secondary education to be placed in union with the special superior studies to which each student is destined, or ought they to be conceived with a view to general culture as a common preliminary to all special studies? 3. Ought the object of superior studies to be limited to the acquisition of professional fitness? 4. What is the best organisation to give to academies or schools of design so that they may fill their educational mission in the interest of the masses? To examine the question from the points of view for the teaching of design (*a*) in secondary schools (*b*), in primary schools (*c*), in technical or industrial schools of all degrees for both sexes. 5. What services can schools in their different degrees, classes for adults, and workmen's societies, render to the army? What services can the army render to general instruction? 6. Scholastic hygiene—What are the principal hygienic conditions to be observed in the construction of school-houses? To develop this question more especially in each of the following points:—(*a*) Lighting; (*b*) cubage of air; (*c*) yards, playgrounds, gymnasia, and other dependencies; (*d*) water-closets, urinals, and lavatories; (*e*) summer ventilation, winter ventilation combined with firing. Health of the teacher.

DR. RICHARDSON, F.R.S., ON THRIFT IN RELATION TO FOOD.*

It we take the twenty-five millions of people, who at this time form the population of England and Wales, and, dropping the millions, place them in our minds as a family of twenty-five persons, variously engaged, we arrive at a very comprehensible and important series of facts. The family easily divides itself into its component parts. We see six members of it—five out of six of whom are women—engaged in the domestic life. We see one—a man—actively engaged in commercial affairs, buying, selling, lending, and conducting transport service. We see two fully occupied in agricultural pursuits, cultivating land, growing food produce, and tending domestic animals. We see six—four of whom are men, two women—carrying out purely industrial pursuits, working at mechanical manufactures, weaving, preparing foods and drinks, or working on animal, vegetable, or mineral productions. We see eight, as scholars going to school, or as children at the nurse's breast, the futures of the great family. We see one, of indefinite life, doing no active work whatever, but tolerated by the community, or helped by it. These make up twenty-four of the family. Lastly, we find one man, the twenty-fifth, standing at the head of the family, directing all its affairs. This man governs, defends, teaches. He is the legislator, the soldier and sailor, the policeman, the clergyman, the lawyer, the doctor, the artist, the journalist, the author, the professor, the schoolmaster. This man owns, practically, all the land, rules all the industry, and is, in fact, as much the head of the family, as the head itself is the chief of the body.

This is the family of the English people proper, living in England and Wales. The question is, how the one man shall continue steadily to minister to the wants of the twenty-four persons under him. Those two men working on the farm, that one man trading, and those four men toiling in the shop, how shall he satisfy them so as to retain their continued support and loyal submission. Just at this moment that is rather a critical question.

The most critical question of all, relating to this family, is, that it shall be well and properly fed, or at all events, shall believe itself to be properly fed; for in truth, it might have all that is sufficient for its want, and a great deal more, and still consider itself over the brink of starvation.

My question is, what shall the twenty-fifth member of the English family teach and practise, in the way of feeding himself and the rest, so as to satisfy both the physical and the mental appetite. The difficulty he is under, in this dilemma, lies in the shortness of hands he has at his command for tilling the land and producing food, and the limitation of land to be tilled. The trader, it is true, comes to his assistance, and gives him a good proportion of food from abroad. If six hundred and fifty pounds in money's worth of food be requisite per annum, to keep this family the trader can ensure one hundred and fifty pounds worth, with promise of more; and so, with the trading supplement, matters go on without much pressure, friction, or disturbance. If the trader should fail in his task, if he should find outside supplies deficient, if he should find his home transformed into a citadel into which his supplies could not be imported without great cost and peril, then affairs would soon be bad indeed. The eight children would cry for bread; the eight women would second the children; the one trader, two agriculturists, and four artisans would be more than troublesome; and the one indefinite would not, I imagine, do anything reasonable to reduce the difficulty.

The facts I have here endeavoured to simplify, so as to bring them home to the minds of all who are interested, are well known to those thoughtful statesmen who forecast the political meteorology with judgment and skill. They know truly that in the grand scheme of nature, carried out in her grandest manner, the principle of life is self-supporting. They know that nothing in nature, not a crumb that falls from the rich man's table, can ever be lost even as food.

While, however, they admit that nothing is lost in nature; that the amount of life on the earth is probably always the same; that death belances life, life death; that the animal life is always safe while the vegetable life is maintained; and that the vegetable life is always safe while the inorganic elements and the forces which move them are maintained; they never cease to detect the danger that exists in individual communities, while life itself is at war with itself, and while one sphere of life is dependent on the temper of another. To this little issue, resting on human passions, do the divine schemes of the universe itself, in their relation to men, come at last. Far-seeing statesmen, therefore, are not surprised at phenomena which, to common minds, come as surprises. They know that in vital human communities, the elements of which such communities are composed may, like saline matter in a saturated solution, remain disunited and mobile for unlimited time; but that the merest concussion, like the fall of a straw into the saline solution, may lead those elements, without loss of their structural essence to crystalise, out in new forms, forms which remain permanent until some other new external and potent influence interferes to re-solve and re-construct once more.

On the food question, as a disturbing influence, different men take widely different views, even after they have appreciated its extraordinary importance. All in England have cause, I think, to admit that England cannot, under existing conditions, find sufficient food from her own soil for herown children. This is the darkest shadow of political calculation and thought that envelopes the nation. It is only an eclipse, and that so partial, as not yet to be visible at Greenwich; but it is present. Some of those who know of it, believe that safety may always be ensured by food supply from abroad, from our colonies, and from other nations, on comparatively easy terms, others think that by increased cultivation at home, by what is called model cultivation, we may so increase supply that we may be sure to meet whatever demands shall be made from increase of population and from increase even of luxury.

To my mind, these often-expressed hopes are at best temporary and partial. When we come, for example, to deal with imported foods, putting aside all political embarrassments that may arise between food-supplying and food-receiving countries, and putting aside all natural failures at the sources of supply, there remain the two great obstacles—pressure of demand at the sources of supply themselves, incident to increase of population there; and cupidity in distribution of food that may be sent to us, after it has reached our shores.

Let me illustrate these points by what has recently occurred from the late importation of animal food from Australia by the *Strathaven*, refrigerating food vessel. I visited that vessel on its arrival in London, and inspected the preserved carcases in their frozen chamber, and I have been able to follow up that great experiment in an instructive manner, as the facts I am about to state will show.

The cargo was purchased in the Colonies at an average of 1½d. per lb.; the cost of freight and expense of engineers is stated as 2d. per lb., making total cost, landed here, say 3½d. per lb. The beef and mutton may be estimated as each costing exactly the same per lb. in the colony. A certain market, even at 1½d. per lb., would satisfy the producers, but the effect of this new outlet would enhance the value of meat in the colony to 2d. per lb., to which add 2d. per lb. for expenses of freight, showing cost on landing here of 4d. per lb. Assuming the meat sold here wholesale at 5d. per lb., the shippers

* Delivered at the Mansion House on Friday, March 12, 1880.

would realise a profit of 1d. per lb., equal 25 per cent., and this should be sufficient to satisfy persons embarking in the trade. The average price of the shipment per *Strathaven*, sold wholesale, was 5d. per lb. for the beef, and fully 5½d. per lb. for the mutton. The Smithfield retail price was 9d. for hind quarter and 7d. for fore quarter, the average Smithfield retail price being 8d. The butcher's retail price was much higher than the Smithfield retail. "I heard," says the informant who furnishes me with these details, "of an honest butcher, who retailed the meat at 7d., stating openly that it was Australian meat; and another West-end butcher sold it to his particular customers at 10d. per lb., also stating it to be Australian." But no doubt many joints were bought and eaten as English.

In this short narrative, we see facts which, however slight they may appear, indicate direction of movement. They show how increase of price within a colony follows naturally on exportation of its produce, and they indicate how quickly, in a consuming community, trade influences modify and increase the cost price and the legitimate profits that should be based upon it.

When we come to deal with the question of model cultivation by the utilisation of all so-called waste products, we find another source of doubt as to permanent results.

It is all right enough to say that we should utilise what belongs to the soil, and that would be a perfect step on the model of nature, if we were at the same time to derive the wasted product originally from the soil to which it is to be returned. This is not the case, however, when we depart, as we now do, from the soil for the original supply. Let me illustrate this by a calculation, which was once made in my "Social Science Review," on a controversy relating to the subject of labourers' plots of produce. These plots were called model oases of produce in the midst of starved acres. The labourer, it was stated, knows that, if on his eighth of an acre of ground, he cannot keep a pig to make manure, he cannot expect a crop. He fattens, consequently, in order to get the manure, one pig. The pig consumes twelve bushels of barley meal, which at seven pounds of meal to one pound of meat would be eighty-four pounds of meat, or four-score, on the one-eighth of an acre, or over thirty-two score per acre. At the same time the garden of this labourer is like an oasis in a desert. It receives in manure thirty-two times the farmer's quantity, and, as the man who makes the largest quantity of meat obtains a proportionate amount, both of manure and produce, the labourer is a model producer.

The reply to this argument was well-handled, and was set-forth as an argument altogether irrevelant to the solution of the question between food supply and population. The labourer truly, so ran the answer, fattens one pig which consumes twelve bushels of barley meal, and makes the one-eighth of an acre an oasis. But thirty-six bushels of barley per acre is above an average crop, so that the labourer actually buys the produce of a quarter of an acre to manure his one-eighth. A very easy way indeed of making an oasis in a desert.

I adduce this illustration because I want it to illustrate a first principle as between food and population, namely, that while we must learn to turn wasted lands into fruitful, by cultivating on them varieties of food, by pushing discovery into new classes of foods, and by ascertaining what will yield different products, and by change of product yield still new products, we are not at model work when we go abroad for the foundation of our produce. To-day our foreign food yields a large part of the manure on which our own lands are directly fed, and from which we derive, through the land on which it is laid, the food it supplies. Thus, as it were, we temporarily import land from abroad, a process which, like the labourers' gardening, may go on very well so long as those abroad will send us what we want, but which would be a pitiful resource if, at any time, those abroad either want all for themselves, or in anger refuse us our requirements.

Whatever view, then, may be taken in respect to foreign supply of food and of model cultivation, we cannot depend in the future upon them. We may, and ought to, cultivate both; we must do so. We must cultivate; and not only cultivate, but establish a *third factor*, which, on the principle of a penny saved is a penny earned, must be second to none other. That factor is *thrift*. Our family of twenty-five must become a thrifty family through every member of it. From the all potent twenty-fifth man down to the indefinite helpless man through all the ranks, thrift must be the order of the day. The six hundred and fifty pounds worth of food should be brought down to five hundred. How that is to be done, is the question. The accomplishment of this object will be best secured in the following ways:—

1. By giving up the use of substances used as foods which are not foods, but are inimical both to health and life.

2. By learning to use foods as near as possible to their first and cheapest growth.

3. By reducing the quantity of food used to the lowest practical working quantity.

1. Of supposed foods to be given up, one article stands out so prominently, that the removal of it alone would almost outweigh the value of all foreign food supplies at present imported. That article is alcohol. Our family of twenty-five spends a good hundred of its income on this article alone, or, turning it into millions, one hundred millions. Lord Derby is reported to have said a short time ago, that of sixpence spent in this way, fivepence is lost. Even that is an extreme view. The little residue, the fraction of food that is present in alcoholic drinks, really does not approach that calculation, while the injury that is inflicted on the family, the cost that is inflicted by the utterly useless and fearfully injurious action of that which inebriates, and does not feed either muscle, bone, nerve, or sense, but degrades them all, is an interest cent. per cent. on the fraction of food, levied with the most rigid and torturing exactitude.

2. In the way of learning to live on foods nearest to the first and cheapest growth, we must bring ourselves to use more freely vegetable foods and the fruits of the earth. The accomplishment of thrift through the use of vegetable substances and fruits is common sense itself, for when we use animal food, we, as a general rule, first use the animal that supplied the food to transmute the vegetable food into animal. It is true one flesh-eating animal may live on the flesh of another flesh-eater, the process is limited in range, and at the bottom of it there must be a first supplying animal that gets its sustenance from the vegetable kingdom. This is only telling, in other words, the truth that there is no primitive form of food, albuminous, starchy, osseous, in the animal world itself. We have, therefore, in procuring the animal in a state for food, to catch it or rear it, to feed it and tend it; to accept the loss of it from possible disease, to go to the expense of killing it and dressing it, and, in the end, to use, after all, but a portion of its carcase for that food which we require from it. All these acts mean money, and, as a rule, money over and above, in great part, that which is spent in merely collecting the primitive vegetable substances which might be as directly applied to the wants of man as indirectly through the animal. The cheapness of vegetable food is plain enough.

3. The next question is that of quality, or of goodness, amount of nourishment of different kinds. Let us test this fact in relation to amount of water in different foods. In the primest joints there is as much as 70 or 75 per cent. of water. There are some vegetables which contain more water than this, viz., potatoes, turnips, cabbages, and carrots; but there are other vegetables which contain infinitely less water. Oatmeal, for example, contains

only 5 or 6 per cent.; good wheaten flour, barley meal, beans, and peas, 14; rice, 15; and good bread, 40 to 45 of water. Taking, then, the value of foods as estimated by their solid value, there are, it will be observed, a large class of vegetable foods which, for solid value, are incomparably superior to animal flesh. Peas, beans, rice, oats, barley, and wheat, are of this class. In the animal foods named, there are 25 parts of solid matter to the 100; in the vegetable foods specially named, there are 86 parts.

If we compute from the solid matter the value of flesh-forming and strength-producing foods on the animal and vegetable produce, we find some other useful facts. In a leg of mutton we find 24 per cent. of solid material, 10·20 of albuminoids, or flesh-forming substance, and 8·76 of fat, or force-producing substance, the rest of it is water. Let us compare that with wheat as a favourite vegetable substance, and we shall find in the 86 per cent. of the solid matter of wheat, 11·50 of albuminoids, or flesh-forming substance, and 71 of force-producing substance, or starch with a little fat. Wheat is, by this calculation, much more valuable than leg of mutton, and the vegetarian would, I dare say, with fair argument, challenge many further similar comparisons. Coming, in fact, directly to matter of quality or goodness, it may honestly be admitted that, weight by weight, vegetable substances, when they are carefully selected, possess the most striking advantages over animal in nutritive value.

The practical lesson is, that man can live most healthily on a condensed vegetable diet, in combination with fresh fruits and green vegetables. Once understood as a matter of thrift, vegetable foods would soon come into general, if not into universal, use. At the same time, there is this difficulty in the advancement of economy by the use of vegetable food, that many persons will always be found who, in spite of repugnance or other objection to animal food, will digest vegetable food that has been prepared for them by passing through the systems of other animals better than when they themselves take it first hand from the plant. The pulses produce in most persons flatulency and dyspepia. Oatmeal causes in many persons heat and dryness of the skin, even when taken with lime juice or fresh fruit; and other difficulties could be named which, at the present, beset the vegetarian in his path. These difficulties are not unsurmountable, but an inquiry is demanded on the point whether the transmutation of vegetable food, which now is obtained by the digestion and passage of the blood into the tissues of lower herbiverous animals, may not be effected by chemical processes, apart from the intermediate animal altogether. When the most scientific instruments possessed by man were the flint head, the iron lance, the boomerang, the sling and stone, the fowling-piece, the rifle and other weapons, for destruction of the inferior animals, or, when improving on these, he has advanced only to the process of herding and feeding animals for slaughter, this question of transmutation of vegetable feeders could not be thought of. In the present day, the circumstances are entirely changed. We know now, to a nicety, the relation of the various parts of food, for the construction of the living body from food, and there should be no difficulty, except the labour of research, in so modifying food taken from its prime source as to make it applicable to every necessity without the assistance of any intermediate animal at all. Changes quite as difficult have been accomplished by scientific labour in the laboratory, and if men of science will, in patient research for a few years, follow up the artificial digestion and condensation of vegetable foods by synthetical imitations, assuredly the perfect production of perfect food from the vegetable kingdom, without the aid of the intermediate lower animal, will be another triumph of science over nature. In the presence of such a development, food of the best kind would become the cheapest of all products, and would be so under the control of man, that new races of men, constructed on better food than has ever yet been prepared, would rise up to demonstrate the greatness of the triumph by their improved physical endowments, and their freedom from certain diseases, which must always occur so long as other living animal bodies are demanded for the reconstruction of the human body.

The quantity of food that is taken is the third particular subject in respect to thrift in food to which I would direct attention. There can be no doubt that the average amount of food taken by the majority of persons far exceeds the amount that is really necessary. The saving that might be made is, I believe, a fair half of that which is actually required by the members of the community that can claim anything approaching to a competency. It is in the great centres of population that this form of economy of food is most urgent, for it is in them that the greatest waste is carried on. In the time of the cotton famine I estimated, in respect to animal food, that the average amount consumed per day in England was seven-and-a-half ounces per person, while in France it was under three ounces. This was by a supposed equal division of the animal food through the whole of these countries respectively; but when the estimate was applied to the metropolitan centres of these countries, it gave a consumption of twenty-two ounces per day for each person in London, and nine ounces in Paris. It is not, however, to be supposed that the enormous over-consumption of food in these great centres was food actually eaten by the people. It was food eaten, and eaten in excess, but it was also food literally thrown away, the value of which has more than once been shown by the application which has been made of it by some thrifty communities. The Sisters of Nazareth-house, at Hammersmith, have been good, and, for ought I know, are still, one splendid example of these thrifty people. Out of the crumbs which fall from the tables of the rich and extravagant, and which these good women collected, they actually fed, during the cotton famine, on good sustaining food, not only their own community, but a hundred other persons who were dependent on them for support, the waste residue from every family of six persons being sufficient, when it could be collected, to keep a seventh comfortably, and in some instances, as I was advised, even a seventh and eighth.

This example of thrift, if but partly copied by the people generally, would soon work an entire revolution in food economy in this country. To be effective, however, the example must come, not from little sisters of charity, but from that twenty-fifth man who heads the community, and especially—I say it in all honesty, and without a thought of offence—from him as he disports himself in such places as the City of London. It is at great and wasteful banquets that the extreme lessons of thriftlessness which so oppose thrift are set forth and praised and practised, and it is in these centres the grand reform should commence.

In the year 1864, when I was writing for the *Medical Times and Gazette* a medical history of Wolverhampton, I chanced to reason with some colliers there, why they should spend their hard-earned wages as they did, in what they called "plaey," which means living for one day in the week on the choicest viands that could be got, ducks, geese, game, lamb, or asparagus, every dainty the season could yield, or money purchase. In reply, one of these grimy epicures, little anticipating how his words would one day be applied, observed, "Gie up pleay, measter; why its ony a feaest loike a Lod Mayor's dinner, if ye've iver bin at un. When us betters gie up pleay, tell us, an we wull." The retort went, and still goes, home. But I take it as one of the most hopeful signs of thrift that was ever known, that, through the liberal-mindedness and the earnest desire for the public good, the moral it so forcibly conveys should be at last permitted by a Lord Mayor of London himself to be repeated even from the banqueting-hall of the Mansion House.

POPULATION AND INDUSTRIES OF CYPRUS.

All agree in stating that the population of Cyprus amounted, in ancient times, to 2,000,000, but it is impossible to ascertain its present number with accuracy; some state it to be more than 100,000, and others, 250,000. From all that can be learned upon the subject, it appears that Cyprus, under the rule of the Lusignans and the Venetians, was flourishing, and contained a large population; that the population, when the Turks took possession of the island, went on diminishing until a comparatively recent date; that, since the year 1840, an increase has taken place, and the period of this increase coincides with improvements which have beeen introduced in the administration. Of the towns, Larnaca is the principal commercial place in the island, both as regards importation and exportation of commodities. It consists of two distinct portions, one, on the sea-shore, called "La Marina," or, more commonly, "Scala," and the other, the town of Larnaka proper, situate further inland, and separated from the former by a tract of open country. Second in importance, as the port of exportation of wines and carrob or locust beans, but better in appearance, is Limassol, which stretches along a coast bearing the same name. Both Larnaka and Limassol lie on the southern coast of the island. Nicosia, an inland town, and the centre of the internal commerce of Cyprus, was, and still is, the seat of the Government. Its aspect and character are not different from those of an ordinary Turkish town.

Cyprus is well provided with building materials. The island abounds in all kinds of stone, from the hardest to the softest, but owing to the inveterate practice of building with bricks, to the great difficulty of transport, and to the entire absence of quarrymen, stone is very little used. The spurs of the northern chain of mountains are rich in good lime and sandstone, and in the southern chain, compact marly limestone of various kinds is to be found in abundance. There is, besides, another quality of stone, which on trial is found to be an excellent material for building purposes. It is quarried on the coast near Kerynia, and is a kind of compact limestone, very much like the *calcaire grossier* of Paris. A palpable proof of this may be seen in the magnificent cathedrals of Nicosia and Famagusta, built of stone at the time of the Crusades and the Venetians; the whole of Famagusta, the ruins of which clearly show that it was entirely built of stone; the churches in the several towns; the hermitages on the ridges of the mountains.

The report by Dr. G. C. Schinas and Mr. E. L. Galizia, upon the capabilities of the island, further states that the vine is beyond doubt the most important plant in Cyprus; and it would probably have been better and more extensively cultivated, but for the existence of an exorbitant tax, which, in the last few years, has caused a rapid decline in this branch of agriculture. There are principally two kinds of grapes, the white and the black. The white grape, which is grown for the fruit in its natural state, is not so sweet as the black, from which are obtained both the common black wine, and the other, inferior reddish-yellow wine, known, both in Cyprus and elsewhere, by the name of *Commanderia*—a name originally given to it because the vineyards, in which it was produced, were a *Commenda* of the Knights Templars, near Limassol. The cost of planting one scala of vines—an operation for which six men and three women are required for half a day—is about 3s. 3d. In many cases, however, the planting of a vineyard costs nothing for labour, the neighbours, by custom, helping each other *gratis*. The vintage takes place towards the end of September, the grapes for the common wine being cut first, and those of the commanderia after. The ordinary average produce is 600 okes of grapes per scala, equal to 1,680 lbs. or 960 rotoli. There were cases in which as many as 2,000 valso, 3,000 okes, were obtained; but these were very exceptional cases. Not unfrequently, however, as much as 1,200 okes of fruit are got per scala. The vineyards deserving particular mention are situate near the village of Lefkara (in the district of Orini), in Solea, and Maratosa, all productive of both black and commanderia wines. In the districts of Kilani and Avdimon, raisins are cultivated in small quantities, and they are of a very inferior quality. Wine-growers keep their wine in store until the next vintage, when, in the absence of other receptacles for the new wine, the old is transferred into tarred leather bags and carried to the towns—chiefly to Limassol. The vats are also coated with tar, which gives the wine a disagreeable taste. This is the more to be regretted, considering that, in the opinion of experienced European wine-growers, excellent table wines could be manufactured in Cyprus in no way inferior to those of other countries. The best commanderia and other wines are manufactured in the villages of Fterícuti, Farmacà, Asca, and Lasagnà; as for quantity, the districts of Limassol, Konklia, and Baffo rank foremost.

With regard to the industrial occupations, the report states that earthenware is manufactured, chiefly in Larnaka, Limassol, Varoscia, Lapithos, and particularly in Korno. At Nicosia, carpets are made, and silk is spun and woven into scarves and other forms, but they are remarkable only for the desirability of their colouring. Silk is also woven in villages, but the colouring process is always carried out at Nicosia. In this town, and in the neighbouring villages, hides also are dressed and tanned, and the article is considered inferior to any other prepared in Turkey. In the districts of Nicosia and Kythrea, under orange trees, violets are grown, from which syraps and jams are made and exported. At Larnaka, Zi, and other places, steam-mills are employed for grinding corn; in Kythrea, however, water-mills are used for that purpose; and in a few other localities mills are worked by beasts; wind-mills are rare, and of a very rough make. They cannot answer well in every locality of the island, but if properly constructed, and in convenient situations, they would be very economical. Sponges are fished from the waters of Kerynia, by foreign speculators; the sponges are of inferior quality. Honey is produced in almost every district of the island, and, owing to the abundance of aromatic wild plants, it is very fragrant and savoury. It is held by some to be inferior to that of Athens. In the district of Lefka, wool is woven and worked for saddles, and for sacks for grain; each of these sacks can contain from 3½ to 5 kilos (or bushels), and costs from 100 to 150 piasters. Iron is also worked in this district, in a rough way; and the fact of ironmongery being confined to one locality, shows how backward this trade is still in the island. In the district of Karpas, common chairs are made in great number, of cypress; they are also of a very rough make, nor can be otherwise, since carpenters and joiners, if they are to be so called, are, as to ability, even behind the blacksmiths. Charcoal is also made, but only for local consumption. Of salt, which is obtained in the most primitive manner, the yield, though very large, might be increased, if more pains are bestowed on this trade. The quantity yearly exported ranges from 10,000,000 to 30,000,000 okes, whilst 1,000,000 okes are generally consumed in the island.

In conclusion, the authors of this report believe, from personal observation, and made during the most unfavourable part of the year, that Cyprus is, by the conformation and the nature of the ground, fit for all branches of rural economy—the mountains, the plains, and the soil being adapted for the growth of all kinds of agricultural produce. The present low condition of agriculture is to be ascribed to causes independent of its natural capability, foremost of which is the scantiness of the population. An increase, especially of the agricultural class, and a better management of farms, would, it is believed, change entirely the present dull and sullen aspect of the island, and restore to it

the prosperity and salubrity for which it was famous in former times. Maltese farmers and agricultural and other labourers would find ample reward for their industry and labour, without in the least interfering with, or creating any obstacle whatever to, the bettering of the present condition of the natives.

WHITE NICKEL BRONZE.

The pure white tint of nickel, its inoxidisability, and therefore the ease with which it is kept clean, have caused it to come into general use for metal fittings, especially those of vessels and carriages, as well as for the bright parts of engines and machines. But, on account of the relatively high price hitherto obtained by nickel, it has been employed chiefly in the state of electro-deposit.

Nickel-plating is effected by two processes, one hot and the other cold. In the former, a solution of sulphate of nickel is used in an enamel cast-iron trough. This is the more rapid method, but its result is not so satisfactory as in the cold process. The latter is effected with a bath of double sulphate of nickel and ammonia, the articles to be nickelised being suspended by a platinum wire attached to the positive pole of the battery, while a plate of pure nickel, to restore the metal to the bath, is put in connection with the negative pole. The nickelisation thus produced, though it requires a longer time than the other process, is finer and more durable.

There are, however, several objections to nickel-plating. The process is injurious to the workmen engaged in it. The thin coating of nickel is liable to peel off, and in the case of parts exposed to wear, or even with cleaning, in course of time, the nickel becomes so worn off at the edges as to expose the base metal beneath. Besides, nickelisation does not entirely prevent the oxidisation of steel and iron.

A French company, La Société Française Anonyme de Nickel, briefly referred to in connection with the Applied Science Exhibition, Paris, are endeavouring to supersede the nickelisation of brass and copper by the use of solid nickel bronze, which is thus obtained. The ore, *garnierite*, extensive deposits of which exist in New Caledonia, the French penal settlement, is worked by Messrs. John Higginson and Co, of Nouméa, the *concessionnaires*. It is by them subjected to a roasting or preliminary fusion, which forms a regulus, containing from 60 to 70 per cent. of metallic nickel. This substance is shipped to the works of the French company, at Septèmes, near Marseilles, where it is smelted into ingots and granules containing 99½ per cent. of pure nickel and ¼ per cent. of utilisable metallic substances. The extent of the mineral deposits in New Caledonia, the reduction in the cost of freight owing to the concentration of metal through the preliminary fusion, and the economy effected by the new methods of reduction devised by M. Jules Garnier, enables the company to sell the pure metal at about one-half the price it obtained three years ago.

For a long time past, efforts have been made to work nickel, but without success, until the present year, because it was found too brittle; now, however, pure nickel has been rolled and forged, cups, knives, and other articles having been formed of it. As a rule, the pure nickel is mixed by the founder with various proportions of copper, zinc, and tin, according to circumstance, to form nickel bronze; but at least 20 per cent. of nickel is required to secure inoxidisability, and to give the desired tint. All articles that are now made of brass or copper nickelised may be produced in solid white nickel bronze, by the same processes, and with the same plant, and at practically the same cost; they are also 20 per cent. stronger, so that in many cases they may be made so much lighter. The great strength and the property of non-oxidisation render this alloy eminently suitable for mathematical and musical instruments. A small quantity of nickel added to steel increases its hardness, and renders it inoxidisable, while edge-tools made of the alloy stand better than those of ordinary steel. A nickel bell-metal is also found to give good results. The Paris Exhibition of 1878 proved the action of a totally new system of metallurgy in connection with this beautiful metal; and that of 1879 showed its practical introduction into most branches of manufacturing industry.

CORRESPONDENCE.

INFLUENCE OF ELECTRIC LIGHT UPON VEGETATION.

Referring to the account, in your last *Journal*, of Dr. Siemens's interesting experiments, showing the marked influence of electricity in promoting the growth of plants, I have been informed that in India, the bamboo, which, it is known, throws up its season shoots at the commencement of the rains, rarely does so with vigour before the occurrence of a thunder storm, which generally ushers in the monsoon, and the heavier the thunder storms, the more rapid the growth, numerous measurements recording from 2 to 2½ ft. in 24 hours, and as much as 70 ft. in 30 days, the greatest activity occurring during the night. Capt. H. H. Sleeman writes (Trans. Agr. Hort. Soc., Ind. IV., 190), "My bamboos at Jubbalpore had not thrown out their shoots at what I considered the usual time, and I asked my gardener the cause. He replied, 'we have no thunder yet; as soon as the thunder comes you will get shoots.' I asked him what possible connection there could be between the claps of thunder and the shooting of the bamboos. 'God only knows,' said he, 'but we know that till the thunder comes the bamboos never shoot well.' The thunder came, and the gardener's theory was confirmed by a very steady and abundant shooting of the bamboos. Here, possibly, the cause rests in the increased amount of nitrogenous compounds absorbed with avidity through the humus which accumulates round the bamboo stocks."

Dr. Siemens's tulip experiment singularly coincides with the above. Thomas Routledge.

Claxheugh, March 13, 1880.

NOTES ON BOOKS.

On Simplicity, Common Sense, and Intelligent Supervision in Sanitary Appliances. By P. Hinckes Bird, F.R.C.S. London (C. L. Marsh and Co.) 1880.

The subjects dealt with in this pamphlet are fresh air, pure water, treatment of excreta, refuse treatment, isolation of the sick from the healthy, and disinfectants. In conclusion, the author asks the question, "Where are the evidences of any real advance whatever during the past half-century?" and he is unable to answer it satisfactorily. He writes—"It has been remarked there has been much talk, a multitude of councillors, periodical alarms, spasmodic efforts, scientific congresses, sanitary conferences, a general awakening to a sense of something defective, but the tangible results have not been even commensurate with the growth of population. On the contrary, the mischiefs of overcrowding and the accumulations of a generation have outstripped the tentative measures of sanitary reformers, and left them panting, halting, and discouraged, in the race far behind. Our bye-ways may be cleaner, and the atmosphere of some towns purer, yet this has been gained at the expense of others, to whom we have transferred the nuisance, changing only the venue without abating the evil."

GENERAL NOTES.

Watford School of Music—The first programme has been issued of the School of Music which forms Section F of the Watford Public Library, from which it appears that the work of the school is divided into three stage—(*a*) elementary, (*b*) intermediate, and (*c*) advanced. Each stage will consist of instruction in singing and in pianoforte playing. At the advanced stage, lectures in the science and history of music will also be given from time to time. Annual examinations will be held in connection with Trinity College, London, and the Society of Arts.

Milk Cooler.—A new form of milk cooler has been introduced by Mr. George Kent, which consists of two cylinders of unequal diameter, connected together above and below. In a receptacle, enclosed in the smaller cylinder, is placed the cooling material, which may be either ordinary cold or iced water. Into the other cylinder, which contains a tap, the milk is poured, when it rises, in both cylinders, to the same level. The milk in the cylinder containing the cooling material soon decreases in temperature, and, sinking, flows through the lower connecting tube as the warm milk pours in through the upper one. In order to prevent the liquid from falling below the level of the top inlet, when the milk is drawn off by the tap, a small cylinder, closed at both ends, and sliding on a rod, is inserted in the cylinder containing the tap. As the milk is drawn off, this hollow cylinder is lowered and held in position by a thumb screw on the top.

Mortality Rates.—In a paper read at the last meeting of the Statistical Society, on "Certain Changes in the English Rates of Mortality," Mr. Thomas A. Welton showed that, since the years 1846-50, there had been a reduction in the English rates of mortality of both sexes between the ages 5-25, but that the rates amongst males at ages 35-75, after being somewhat diminished, had become higher than they were, to the extent of 15 or 20 per cent. above the minimum. In conclusion, the author showed "that there has been a steady increase during the whole of the period in male mortality after 35 years of age by diseases of the lungs, heart, and brain, and also the less important diseases of the kidneys, and cancer. Such increased mortality has been so general, even in the rural divisions of the kingdom, that it seems difficult to attribute it to the increased strain upon the vital energies occasioned by modern conditions of life; but he did not attempt to assign a cause for the changes which have taken place."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

APRIL 7.—"Buildings for Secondary Educational Purposes." By E. C. ROBINS, F.S.A., F.R.I.B.A. Professor A. W. WILLIAMSON, F.R.S., will preside.

APRIL 14.—"The History of the Art of Bookbinding." By HENRY B. WHEATLEY, F.S.A., Assistant Secretary of the Society. Lord ALFRED S. CHURCHILL, Chairman of the Council, will preside.

APRIL 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. HOLMAN HUNT. Sir COUTTS LINDSAY, Bart., will preside.

APRIL 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By THOMAS FLETCHER.

MAY 5.—"On the last Forty Years of Agricultural Experience." By JOHN C. MORTON. JAMES CAIRD, C.B., F.R.S., will preside.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

APRIL 2.—"The Best Route for a Line of Railway to India." By B. HAUGHTON, C.E.

APRIL 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. VAMBÉRY.

MAY 7.—"The Present Condition and Prospects of Agriculture in South India." By W. ROBERTSON, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

APRIL 6.—"Art in Japan." By C. PFOUNDES.

APRIL 27.—"Iceland and its Resources." By C. G. W. LOCK.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

APRIL 8.—"On Recent Improvements in Benzine Colours." By F. J. FRISWELL, F.C.S.

APRIL 22.—"On Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MAY 13.—"On the Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. ADAMS, F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock.

The Third Course will be by Mr. R. W. EDIS, F.S.A., on "Art Decoration and Furniture." It will consist of six lectures, to be given on the following dates:—April 5, 12, 19, 26; May 3, 10.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 22ND...Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Edward Hutchinson, "Notes of an Ascent of the River Binué in August, 1879, with Remarks on the Systems of the Rivers Shari and Binué."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 23RD...Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Prof. Abel, "Explosive Agents Applied to Industrial Purposes."

British Horological Institute, Northampton-square, 8 p.m. Mr. R. Strachan, "International Weather Service."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. V. Ball, "Nicobarese Ideographs." 2. Mr. Alfred Taylor, "A New Method of expressing Degree of Changes of Specific Form in the Organic World, especially referring to the Development of the Mind and Body of Man." Illustrated by numerous Diagrams.

Royal Colonial, "Pall Mall," 14, Regent-street, S.W., 8 p.m. Sir Arthur Blyth, "South Australia, her Land Laws and Recent Industrial Progress."

Royal Horticultural, South Kensington, S.W., 1 p.m.

WEDNESDAY, MARCH 24TH...Geological, Burlington-house, W., 8 p.m. 1. Mr. Searles V. Wood, "The Newer Pliocene Period in England." 2. Mr. G. R. Vine, "A Review of the Family Diastoporidæ for the purpose of Classification."

Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. Adjourned discussion on Mr. Alexander Siemens's paper on "Some Recent Improvements in Electric Light Apparatus."

The letter on "Domestic Poisons," printed in the *Journal* (vol. 28, p. 341) was signed "John Crossley and Sons, Limited, per Edward Crossley, director," which is the proper name of the firm, and not "Edward Crossley and Sons."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,427. Vol. XXVIII.

FRIDAY, MARCH 26, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1880, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For.Memb.R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to M. Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

The Council invite members of the Society to forward to the Secretary, on or before the 24th of April, the names of such men of high distinction as they may think worthy of this honour.

APPLIED CHEMISTRY AND PHYSICS SECTION.

March 11th, 1880; Prof. Roscoe, F.R.S., in the chair.

The paper read was on—

BALMAIN'S LUMINOUS PAINT.

By C. W. Heaton, F.C.S.

I have been invited to give, this evening, an account of one of those practical applications of science which have always had peculiar interest for members of this Society. In doing so, I shall be compelled to allude briefly to some scientific truths, familiar to many among my audience, and particularly to those who attended Mr. Preece's recent interesting lectures.

Every one knows that a ray of white light consists of minute waves, or ripples, analogous to those of water, and of various lengths. The mean

length of these waves, measured from the crest of one to the crest of the next, may be taken as the fifty thousandth of an inch. They all travel in straight lines, and all with the same velocity, a velocity which is called the velocity of light. In passing through a prism, these lines of waves are refracted, or bent at different angles, and when afterwards allowed to fall on a screen, they are reflected back to our eyes, and a portion of them, acting on the optic nerve, produce the sensation of colour. These rays are, therefore, called the visible rays. Here on the screen you see the spectrum of the white electric light.

The eye is, however, a very imperfect optical instrument, and is only sensitive to waves between certain limits of length. The real spectrum on the screen is much larger than the visible one. There is a portion beyond the red, which is called the ultra-red portion. The waves of this portion are too long to affect the eye, but are powerful in producing the phenomena of heat. The rays are, therefore, sometimes called the invisible or obscure heat-rays. There is also a portion beyond the violet, produced by waves too short to affect the eye, but active in producing chemical and other effects. These rays are called the ultra-violet, actinic, or chemical rays.

Many years ago, Sir John Herschel observed the peculiar blue opalescence which a solution of quinine presents when held in certain lights. Brewster made further observations of the same kind; but it was not until 1852 that Prof. Stokes, of Cambridge, published the memorable research on the subject, which would alone have been sufficient to render his name immortal in the history of science. Stokes suggested the name, fluorescence, for the phenomenon, and showed that it was due to a power, which some bodies possess, of absorbing light waves, and emitting them again as longer waves. Quinine is peculiarly sensitive to violet and ultra-violet rays. If I pass a solution of quinine through the spectrum, beginning at the red end, you will see that the fluorescence does not appear until we reach the blue portion, but continues to be visible far beyond the violet. In the ultra-violet portion, we have a distinct conversion of invisible actinic into visible light rays. Here is a solution of the new Magdala red, made from naphthaline. It appears black in all parts of the spectrum, except the region of the yellow, in which it shows a magnificent red fluorescence. This experiment proves that fluorescence is not always caused by the conversion of invisible into visible waves. We now throw a beam of electric light, filtered to some extent from heat rays by passing through ammonio-sulphate of copper, on two jars of water, and throw into one a solution of quinine, and into the other an alkaline solution of the curious compound called fluorescine. You perceive in the one case a blue and in the other an intense emerald-green fluorescence, and it is really difficult to believe that in each case the solution remains transparent. In fluorescence, then, we have generally, if not always, an increase of wave length, due to the molecular action of certain substances. The waves are never shortened, and are sometimes described as suffering "degradation." The luminosity ceases as soon as the incident light is withdrawn, or, to speak more cautiously, it lasts only for a minute period of time afterwards. In the case of quinine, the work of converting invisible into visible rays, seems to take about the 5,000th part of a second.

We come now to a closely allied, if not identical, phenomenon. Many substances are known which, having been exposed to light, continue to emit light for measurable periods of time after the luminous source is removed. This phenomenon is called phosphorescence, and it is with this that we are chiefly concerned to-night. The term phosphorescence has been applied to light emitted under various conditions. Thus we have the light emitted during the slow oxidation of phosphorus; the light of living animals, such as the glowworm and the noctiluca; the light attendant upon incipient putrefaction, animal and vegetable; the light produced by the heating of phosphorus, and many other bodies; by percussion, as when sugar is struck with a hammer or rubbed, and the beautiful phenomena developed in high vacua in that strange condition of matter with which Mr. Crookes's remarkable discoveries have lately made us familiar; and, lastly, we have the light which follows insolation. All these are grouped together under the general term phosphorescence, but it is with the last one that we have at present to deal.

The history of discovery in regard to this kind of phosphorescence is a somewhat lengthy one. Obscure hints of the phosphorescent power of gems are contained in some of the works of the ancients, but nothing definite was discovered until about the year 1602, when a shoemaker, of Bologna, named Vincenzo Casciorolo, picked up a heavy stone, and being an enthusiastic alchemist, took it home and treated it in his furnace, in the hope of obtaining gold from it. Instead of getting gold, he obtained a mass which shone in the dark, and which became celebrated as the Bologna stone, or Bologna phosphorus. The stone was the now well-known heavy spar, and acted on by carbon it yielded barium sulphide, a compound of considerable phosphorescent power. In 1663, Boyle published some observations on the phosphorescence of the diamond, and, in 1675, Baudoin obtained another phosphorus by the action of heat on calcium nitrate. Some important additions to our knowledge were made by Beccaria, in 1744, and then came the discovery by Canton, in 1761, of the phosphorus or pyrophorus which bears his name. It is made by calcining oyster shells with sulphur, and consists, of course, essentially of calcium sulphide, which is the most remarkable of phosphorescent substances. Thanks to the kindness of my friend, Professor Tuson, I am able to show you a sealed tube containing a specimen of this substance prepared by Canton himself, with the date 1764 engraved on the glass. It still retains its power, a remarkable proof that the luminosity is not due to any chemical action.

In 1775, Wilson published some valuable discoveries. He extended the list of phosphori, showed that light of various colours could be obtained from them, and made some interesting observations on the effects of heat and cold, to which I shall refer again. I have here a sheet of cardboard painted with various phosphorescent compounds, and a butterfly painted on glass in the same matter. On exposing them to light, you will observe the different shades of colour, varying from red to blue, which are developed.

Passing by, in this imperfect sketch, several important names, we come to the greatest name of all Edmond Becquerel, who for more than thirty years has enriched science by his discoveries. It is impossible for me to give even an abstract of these discoveries. He invented an instrument called the phosphoroscope, by which he was able to detect the phosphorescent power in bodies which remain luminous for very short periods of time. He showed that the power was a very common one in natural, as well as in artificially-prepared substances, and that it was possessed by organic as well as inorganic compounds, and particularly by all fluorescent substances. He analysed the light emitted in each case by the spectrum, and determined its duration within certain limits of accuracy. These limits are singularly wide, extending from less than the 5,000th part of a second, to hours or even days. Of all phosphorescent bodies, the sulphides of calcium, barium, and strontium, are the most remarkable in regard to the duration of their light; and Becquerel has studied the modes of preparing these compounds with the greatest care, and has revealed many strange, and even startling facts in regard to them. They can be prepared by the action of carbon on the sulphates, by the action of sulphur on the oxides and carbonates, and by the action of alkaline sulphides, and even of antimony sulphide, on the last-named compounds. The phosphori prepared by these various processes, differ widely in regard to the colour and duration of the light which they emit; and it is even possible to obtain shades varying from orange-red and indigo-blue, from calcium only. But this is not all. The calcium-sulphide obtained from calcite, is different from that from arragonite, though these minerals have the same chemical composition; and the differences remain even after each mineral has been dissolved in acid, reprecipitated by sodium carbonate, and then ignited with sulphur. This affords a strange, and for the present, inexplicable example of molecular persistency. Becquerel holds that fluorescence and phosphorescence are one and the same phenomenon, the apparent differences being due solely to the different periods during which the absorbed light is emitted. The point is one which merits attentive study.

We now come to the immediate subject of my paper. The late Mr. Balmain, formerly of University College, and an excellent chemist, had for years made a special study of phosphorescent substances. He enjoyed the friendship of the Becquerels, father and son, and aided possibly by them, he succeeded in producing a constant and very powerful phosphorescent substance. Here is some of the substance. You see how strong a light it emits after exposure to the magnesium light. It occurred to him to patent the use of this and other phosphorescent materials, mixed with water or oil, as paints capable of being applied in the ordinary way to any surface. This patent for luminous paint is now in the hands of Messrs. Iblee and Horne, of Aldermanbury, and, thanks to those gentlemen, I am able to show you a great many specimens of articles thus painted, and so to enable you to judge for yourselves of its proposed applications. I have, in the first place, a number of sheets of cardboard so painted, some of them framed and glazed, which you see emit, after insolation, an amount of light which is really remarkable. With these sheets, we can try a few preliminary experiments, which will assist in illustrating the nature of the phenomena with which we are dealing. Let us, in the first place, test the sensitiveness of the paint. Exposing a sheet of painted card, previously kept in darkness, to Leyden jar sparks from an induction coil, you see that each spark impresses its image on the card, and makes it luminous. It is easy in this way to write luminous words on an otherwise dark card. You know how very short a time each spark lasts, and can, therefore, judge of the short time required for the illumination. The same fact is more roughly shown by striking a lucifer match in front of a dark pane. The momentary flash of the tip is, you see, enough to produce a very visible effect on the paint.

We may now try the very obvious experiment of applying light of various colours to the painted surface. Here is a card partially covered with sheets of blue, green, yellow, and red glass. Burning a piece of magnesium in front of it, you see that no effect at all is produced by the red and yellow light, a considerable effect by the green, and most of all by the violet light. The same effect may be produced in another and less ambiguous manner. We will throw the spectrum on a white screen, which consists of five horizonal layers. The upper one is white paper; the next, sensitive photographic paper*; the next, paper saturated with quinine; the next, luminous paint, which at present is dark, and the lowest luminous paint previously insolated. The spectrum covers all these layers. A long exposure is required to give a very satisfactory result, but we are then able to make out that there is great general similarity between the rays which affect the silver, the quinine, and the luminous paint. The affected portions are nearly, but not quite, coincident. If the experiment is carried on for a long time with a very intense spectrum, another effect which we could not have anticipated is observed in the lowest layer, which has previously been made luminous. The violet and ultra-violet rays increases the luminosity, as we might have expected, but the yellow and red rays not only do not add to the luminosity, but actually take away the light previously present. Another experiment will show this effect more quickly. Here is a sheet, at present luminous; I cover half of it with opaque cardboard, and the other half with yellow glass, and then burn a piece of magnesium in front of it. See the result. The rays which passed through the yellow glass, have taken nearly all the light out of that half of the card, while the light on the other remains unimpared.

For an explanation of this curious phenomenon, we must go back 105 years, to Wilson, who first observed it, though in a different manner. We must remember that red and yellow rays are also heat rays; and Wilson showed that heat would stimulate the light for a time, only to cause it more rapidly to disappear. On a faintly luminous pane I place a can of hot water. Removing it after a minute, we find that the light in that place is much brighter than before. Cold diminishes the light, which, however, returns when the

* Kindly prepared for me by Mr. J. M. Thomson, of King's College.

original temperature is restored. This I can easily show, by applying a block of ice for a minute to the luminous surface. Thus we see the importance, in all experiments on the duration of phosphorescent light, of paying close attention to temperature.

We may now inquire how far this luminous paint is suited for actual use, and what kind of applications can be found for it. We have seen that it is very sensitive to artificial light. To ordinary daylight it is at least equally sensitive, and I have seen it tried, with a success which seemed to me wonderful, in a thick yellow London fog. A very short exposure produces the maximum of illumination, though, of course, the amount of this illumination depend on the quantity and quality of the light. The duration of the light is likewise dependent, to some extent, on conditions. When the paint has been exposed to the intense light of the sun, or of burning magnesium, a good deal of the brilliancy disappears quickly, but after that the fading is very slow; and it may be said that a more or less useful light will remain through the length of an ordinary winter's night. In an extreme case, I was just able to see the dial of a watch by the light emitted from a card which had been in total darkness for twenty-six hours. In this case the card had been exposed to daylight of moderate intensity for two hours.

The next point to be considered is the durability of the paint. The oil seems to protect it wonderfully, even from the acid air and rain of London. I have seen a wooden bowl, which was painted by Mr. Balmain more than a year ago, and has for several months been exposed to the open air in London, in very bad weather. It still preserves its power. Equally effectual is the oil as a protection from water. Here you see the painted model of a life-buoy immersed in water. Its luminosity is very evident. In several respects, therefore, namely, as regards intensity of light, lasting power, and durability under fair condition, these painted surfaces seem likely to be useful as carriers of daylight into dark places and through dark hours.

Let us now turn to the suggested applications of the paint. They may be divided roughly into the ornamental and the useful, and I need only mention a few out of the many that occur to the mind. In the former class, we may include these painted india-rubber balls, which are very pretty, and suggest nocturnal lawn tennis. Statuary, grotto-work, and ornamental tiles, also give striking and beautiful effects. Here is a large bust of the Prince Consort which has been painted and illuminated. You see how fine an effect it produces. Clock faces, so prepared, show the time all night, and watch-boxes enable us to do as much for our watches. The ends of lucifer match boxes have been painted with the same material. Here are a number of them. There would obviously be no difficulty in finding one of these boxes in the dark.

To pass to more important applications, the roofs of railway carriages have already been treated experimentally with the paint, with results that appear satisfactory. The light would, of course, only be employed for daylight trains which run through tunnels. Then, again, it is proposed to paint the names of streets, the directions at post-offices, sign-posts, and advertisements in the same way. Here are some framed notices, "Lodgings," "To Let," and such like, which would easily be seen through, at any rate, a great portion of the night. Still more important is the use of this luminous paint in gunpowder magazines, spirit stores, and for purposes of exploration in coal mines during seasons of danger, besides many such uses that may be thought of.

But of all the proposed uses of the luminous paint, none seem to me so important, or so certain of practical success, as the marine applications. Several of these have already been realised in a satisfactory manner. For signal and mooring buoys, for example, its utility is obvious. It is of the utmost importance that the buoys employed for marking channels should be seen easily, the safe entrance to a harbour or river frequently depending upon the successful passage through a line of buoys. The entrances to Poole Harbour and to the mouths of the Thames and Medway are marked in this way, and great difficulty and danger are often experienced on dark nights in making out the buoys. Now, there can be no doubt that a buoy thickly painted with luminous paint would remain visible through the whole, or nearly the whole, of a night. A few evenings ago, I assisted at the trial of a small mooring-buoy at Erith. It was not placed in the water till nine at night, having, of course, been for some hours before in darkness. We found that it was easily visible at distances of over a hundred yards, although the night was not a clear one, and the light to which the buoy had been exposed had not been very good. Yatchsmen, returning to moorings late at night, would find such buoys a great advantage, and many collisions might in this way be avoided. Equally important is the application of the paint to life-buoys. Life-buoys are, or should always be, kept on deck in convenient situations. A life-buoy thrown to a man overboard will often save his life, particularly if the man can swim. But what is the use of throwing out a common life-buoy on a dark night? It is impossible for the man to see it, and it is equally invisible to those on board. Here is a life-buoy painted with the luminous paint. It has been on the roof of this house all day, and has, consequently, been now for several hours in darkness. Yet you see it emits a light that could easily be seen at a very considerable distance. Any decently good swimmer could easily reach it, while the ships' boats would know at once the point to which they must row.

Finally, there seems no doubt of the usefulness of the paint in diving and other submarine operations. We have ready a driver in full dress, painted all over with the luminous paint. He is being illuminated in the next room. Now he enters, and you see what a brilliant and ghost-like appearance he presents. At present one of the greatest difficulties in submarine operations arises from the intense darkness. With this new arrangement every diver will be his own lanthorn, and will carry down with him a stock of daylight that will assist his labours materially. This dress was actually so used at Southampton a day or two ago. Mr. Phillip Hedger, the Superintendent of the Southampton Dock Company, has sent a letter to Messrs. Ihlee and Horne, in which he says, that the diver descended, on a somewhat murky day,

into 27 feet of not very clear water, and found that he was able to distinguish the bolt-heads and mussels on a ship's bottom with ease. Mr. Hedger seems to entertain no doubt of the success of the new application.

Let me, in conclusion, draw your attention to the splendid inscription, "Balmain's Luminous Paint," which stretches in letters of fire the whole length of the hall. It has been in darkness for two hours, and yet illustrates very simply the way in which the paint may be made useful for advertising purposes.

I may now conclude this brief and very imperfect sketch. I heartily wish the exposition had fallen into better hands, and particularly that our Chairman, whose well-known researches on actinic light have added so much to our knowledge, would have taken the matter in hand himself. However, I have done my best, and can only hope that you have acquired some new ideas on the subject, and will in future watch with interest for further useful applications of the luminous paint.*

DISCUSSION.

The Chairman said they were all much indebted to Professor Heaton, and also to the gentlemen who had placed the material in his hands, and enabled him to produce such very beautiful results. He (the Chairman) had felt a very great pleasure in being present that evening, for the very simple reason that the gentleman whose name was now connected with this very interesting discovery was one of his earliest friends. The late Mr. Balmain was not perhaps known to many, but by those who had the pleasure of his acquaintance and friendship, his name was always remembered with affection. He was one of the real servants of science, one who worked quietly and industriously, and thus produced those results which they they had all so much admired that evening. They must all feel deep regret at his untimely death, just at the moment when his interesting experiments and researches had come to such a successful issue.

Mr. Pearsall said that many years ago he worked at the Royal Institution on phosphorescence, and it had given him great pleasure that evening to listen to the paper, and witness the experiments. He then referred to some of the practical applications of the invention, such as for the names of streets, shops, railway stations, &c. The application to life-buoys would be exceedingly useful, and, although the light might be evanescent, yet it appeared sufficiently permanent for such purposes. He saw no reason why the buoys should not carry an electric battery, which might be excited by the water, or, perhaps, also, that the interior of coal mines should be white-washed with this luminous paint.

Mr. Newlands asked if the paint were procurable, and at what price.

Mr. Horne said that the paint could be obtained at their offices in Aldermanbury, and, roughly speaking, cost 28s. per lb. Two years ago, it began at five guineas per lb.; they had now brought it down to 28s., and he believed the more they reduced it in price the larger trade they would do, and the more profit would arise. Being only made from a compound of lime and sulphur, something higher in oxidation than a sulphide, and lower than a sulphate, it should cost, roughly speaking, less than white lead; and when this time arrived, no doubt tunnels and many dark corners might be whitewashed with it. Last week, an experiment had been made on the Great Western Railway, a coach being run with the ceiling painted with it, although not in the way they had suggested. They brought it forward as a question of economy, to light up tunnels in the daytime; but the railway company tried it in a severe manner, by running a train from Bishop's-road Station underground to Moorgate-street and back. Some members of the press and a representative of the Great Northern Railway were present, and the latter was so pleased with it that the company was going to place a coach at their disposal.

Mr. Newlands asked how much surface 1 lb. of paint would cover.

Mr. Horne said, roughly, about 28 square feet.

A Member said he understood that this paint would only give off light after it had been already exposed to a strong light; and that, therefore, he did not see its applicability to mines.

Mr. Horne said it was for such purposes they devised what were called the Aladdin Lamps, which were about $1\frac{1}{4}$ feet square, and might, in fact, be called portable daylight, as they did not require either gas or pipes.

Mr. Eckstein asked if one application would be sufficient.

Mr. Horne said it should be allowed to dry two or three days, and was all the better for having two or three coats.

Prof. Tuson said he understood this patent claimed improvements in the preparation of this phosphorescent body.

The Chairman said, as he understood, Mr. Balmain's patent consisted in the application of this compound, containing sulphur, and an alkaline earth metal, and, perhaps, some oxygen. As a paint, the method of manufacture had been improved, so that the luminosity lasted for a greater length of time than had hitherto been accomplished.

Mr. Harding asked how long exposure to magnesium light or sun-light was required to produce an effect lasting for ten hours.

The Chairman said they had seen sufficient evidence of what a short exposure to magnesium light would accomplish, which had proved the case so far as the luminosity of the surface was concerned. How long that would last, Mr. Heaton would, no doubt, tell them; but the experiment of the lucifer match-box, which was so very striking, showed how small an amount of light caused the luminosity.

Professor Abel said he had been very much struck with the lucid manner in which the scientific aspect of the question had been explained, as well as by the practical results achieved by the application of these very beautiful researches of M. Becquerel. There could not be a doubt that, as in many other instances of important applications of scientific research to practical use, it soon received very important development, and was destined to have many useful applications, which, no doubt, would be assisted by the manner in which the matter had been made public in that hall. Although he came almost fresh to the practical aspect of the question, he could see many directions in which he should be sanguine of its very useful application. Without going so far as to think that you could dispense with lights in powder magazines altogether, except under certain special conditions, or that you would be able to illuminate coal mines, or that you would deal with light in a very simple manner at great depths under water, still in all these directions these phosphorescent preparations were likely to have very useful results. He felt quite sure that, in the hands of

* I must here express my sincere thanks to my friend, Mr. Bolas, himself so excellent a lecturer, for his invaluable help in the experimental portion of my paper.

Mr. Heaton and others, its manufacture was likely to become of very considerable use to arts, to manufactures, and to a variety of important purposes directly connected with humanity, and with the daily increasing enlightenment of the age.

Professor Grylls Adams said the scientific side of the subject had been put so clearly before the meeting, that there was really no question to ask, and there was scarcely any room left to discuss that branch of the subject; this was evident from the fact that no question had been asked upon it. Professor Heaton had so clearly shown what kind of light it was which had this phosphorescent effect, namely, "that at the extreme end of the spectrum," which was taken up by this phosphorescent body, and converted into visible light. The next question naturally was the practical application of this invention, which Professor Heaton had been compelled to compress into a few minutes. No doubt, if he had gone on considerably longer, he might have given several more interesting applications, which would, perhaps, have met some of the questions which had been since put; but, as a lecturer himself, he knew it was always dangerous to presume on the patience of an audience, and go beyond the allotted time. He very much admired the results and the rapidity with which they had been produced, and the very slight exposure necessary to give a luminous effect, coupled with the lasting of that effect for a long period. No one would wish to detract from the merits of those who had followed up Mr. Balmain's application, and put it to the practical application which had been shown, because it was evident that, if similar applications had been made before, the public would have known of them, but there could not be the slightest doubt that, to nearly all the audience, these results were entirely new.

Mr. Horne, on behalf of the owners of the patent, express their thanks to the Society for the opportunity of exhibiting this material, and also to Professor Heaton for his ability in treating the subject, and to many friends who had helped, notably to Mr. Philip Hedger, many years superintendent of the docks at Southampton. He could quite bear out the Chairman's remarks as to the character of the inventor, having had the pleasure of his friendship during the last two or three years of his life. That gentleman had studied this subject for forty years, and seemed to have pretty well exhausted it.

Mr. Aflano said they had heard about this patent being used for submarine explorations, and for life-buoys, but why should it not be used for the ships themselves? If vessels or their spars and masts were painted with it, it would tend to prevent collisions, and save human life.

Professor Heaton said this had been suggested already, although he had forgotten to mention it.

Mr. Holdsworth Fisher asked if the luminosity might not be attributed to a chemical action rather than a physical one, something similar to that produced by the chlorophyll in the leaves of plants, which decomposed the carbonic acid of the air. Might it not be possibly the effect of the actinic rays of light setting up chemical action amongst the ingredients of the paint, leading to a slow combustion of the sulphide, by which the sulphur would be set free, and thus a process of slow oxidation might possibly take place. That idea seemed partly borne out by the similarity between the colour of burning sulphur and of this luminous paint shining in the dark.

Professor Heaton thought this was quite impossible, since there was a tube on the mantel-piece, prepared more than 100 years ago, which still possessed this power. He did not think it possible for chemical action to go on so long.

Mr. Berwick said he had been testing this paint recently in country roads where gas had not yet reached. It certainly did not light you along the road, but it prevented a vehicle running against you, and would be very useful upon direction posts to travellers. In fact, every dark corner where there were railings, or anything on which the paint would dry, might be coated with it. Testing it one day in a dark railway station in Sussex, where there was no gas, he showed that if only the railings were painted with it, it would give sufficient light to run the train in.

The Chairman said he would not detain the meeting with any further remarks of his own, except to propose a vote of thanks to Professor Heaton and the patentees, for the interesting lecture and experiments. If those who had been present only remembered the lucifer match-box, they would appreciate Balmain's application of phosphorescence, and he trusted before long its use would become general for that and similar purposes.

MISCELLANEOUS.

GEOGRAPHY, POPULATION, AND PRODUCTIONS OF THE PROVINCE OF SHANTUNG, CHINA.

The province of Shantung, in which is situated the Treaty Port of Chefas, or Yentai, contains about 66,000 square miles. It is divided into 12 departments, which are subdivided into 107 districts. Each district has in it a district town, wherein resides the officer who govern the district. The towns, except when, as capitals of departments, they take the name of the department, are known by the name of their respective districts. The province has several harbours, principally that of Chefoo, which is protected only to a certain extent by the Chefoo Bluff from the prevalent north winds, and is weighted by great disadvantages, for, though tolerably safe as an anchorage, loading and discharging cargo can only take place when its waters are smooth. The other harbours are Lungmen harbour, which is too small and shallow for any vessels, except small junks; Weihaiwei, Shiktao, Litao, Chinghaibay, and Chiaochow. The two principal water communications of the province are the Grand Canal and the new Yellow River. The Grand Canal runs from outside the walls of Peking, by Tungchow, in a south-east direction, to Tienkin; here it bends to the south-west, and, running about 100 miles, enters the province of Shantung at Techow, where it crosses the main land route to Peking. The second water communication, the new Yellow River, is only of recent formation. The old Yellow River used to empty itself into the sea in the Kiangsu province, about longitude 120° east 34' north; but in 1847, it found a new bed, and now empties itself into the sea at about longitude 118° 25' east, latitude 37° 45' north. It is only navigable by large junks to a town called Tietsnum Kivern, a few miles from its mouth. There are besides in the province many rivers which are navigable by small barges, but about them we have but little information. The population has been estimated at 30,000,000, or 454 to the square mile. If this estimate is correct, Shantung must be peopled half as densely again as Great Britain, and far more densely even than Holland or Belgium. Consul Gardner confesses that at first he was very sceptical on this point, but, having taken the trouble to count the houses in 150 or more villages and towns in 100 square miles, in the vicinity of the port of Chefoo, and reckoning five inmates to a house, it would appear that the population would be 94,000, of which the town of Yentai would give 30,000, and that of Fushan 10,000, the other 54,000 being distributed among agricultural villages numbering from 200 to 3,000 inhabitants.

Of this 100 miles, some 10 per cent. is covered by uncultivated and uninhabited hills, ranging from 300 to 1,300 feet high. The densest populated parts of the province are the country round Tsinan and the rich alluvial plain stretching from sea to sea, containing the districts of Changi, Kromi, Pingtu, Chuckeny, Chiaochow, &c., in which is principally cultivated wheat, and which produces the straw braid now so important an item in the trade of Chefoo. The estimate, therefore, of 30,000,000 inhabitants to the province, though astonishing, is not incredible. It is supported by the native official returns which, though not trustworthy, are approximate to the truth by the fact that the products of the large fisheries are almost entirely consumed; that the importation of grain employs hundreds upon hundreds of junks; and, further, that foreign vessels brought to Chefoo, during 1878, as many as 232,000,000 needles.

Amongst the natural productions of the province, the first place is given to minerals; these consist of gold, silver, copper, tin, lead, coal, and iron. The best quantity of the latter is found close to Tangchow and in the Chuchow, Laiw, Tsoping, Changshan, Poking, Putai, and Pinchow districts. The presence of sulphur is indicated by hot sulphur springs in the Teiksia district at Ai-Shantang and Wenshuitang, about 50 miles west of Chefoo, and probably in many other places. The sulphur spring at Ai-Shantang is at the height of about 300 feet above the sea level, directly under the noble Aishan hill, which rises in solitary grandeur 2,500 feet, and seems like the gigantic dome of a cathedral. The heat of the stream outside the bath is 120° Fahr., and inside, 112°. The sulphur spring at Tungchuantang is at the south end of the plain, between the sea and the Rugged Range. Though nearly on the sea level, it is in close proximity to hundreds of fantastic parks, amongst which is to be found the wildest and grandest scenery of the province. Of precious and valuable stones, the jade is found near Laichow, and in the Laiyang and Changching districts. This jade is very inferior to the jade of the Himalaya, Alai, and Thibetan mountains. Marble is found at Ping-tu. Amethysts are found in the Chiehmo districts, near Yenchow and Ichow. Diamonds are found in all the coal fields, but, up to the present time, those discovered have been very small. It is doubtful whether the search for them would be remunerative. Granite and sandstone are found in all the hills of the province.

The fruits produced in the province are dates (not the palm-tree date), walnuts, peaches, nectarines, plums, cherries, pears, apples, melons, almonds, and grapes. Strawberries have been introduced by Europeans, and thrive well. The natives have not, however, taken to their cultivation. Raspberries grow wild all over the hills, but have not been admitted into the orchards. Much of the dried fruits, such as dates, walnuts, melon seeds, almonds, &c., find their way to Chinkeang and Shanghai by the Grand Canal. Owing to the native ignorance of horticulture generally, and of grafting particularly, the only fruits of good quality are the walnuts, grapes, plums, and melons. The vegetable productions of the province are silk, cotton, rice, wheat, straw-braid, vermicelli, millet, sorghum, hemp, maize, castor oil, beans, bean-cake, bean oil, chillies, ginseng, indigo, lily flowers, liquorice, medicines, sesanum, seaweed, cabbage, and opium. Of all the exports of the country, that of straw-braid is in the most flourishing condition, grown, as before stated, in the Laichow department. Chefoo is the natural port of its exportation. Increasing steadily every year, it will probably soon be the mainstay of the export trade of Chefoo, and its sale will, by enriching the 5,000,000 or so inhabitants of the Laichow and Tangchow departments, enable them to purchase far more largely than hitherto of our textiles. The exports of straw-braid, which in 1873 was only 1,363,054 lbs., had increased in 1877 to 2,730,606 lbs., and amounted in 1878 to 3,736,268 lbs., value, £231,181. Besides this, 42,296 straw hats were exported, value £1,057. This trade is entirely in foreign hands, almost all British, and the produce is exported entirely in foreign vessels. The annual productions of the province are of little value. They are as follows:—Salt fish, *biche de mer*, pigs' bristles, felt, wool, horns, tallow, and skins. The rocks of the coast are covered with oysters of a fine flavour, which would only require a little cultivation to become a valuable article of export.

When considering the advantages of this province, Consul Gardner remarks that one is reminded of the old nursery tale, where all the good genii bestowed their choicest gifts, but the malediction of one malevolent fairy mingled a curse with every blessing. No spot on earth is more bountifully supplied by nature with all that renders a country rich and prosperous than Shantung. Its climate, hot in summer and cold in winter, is bracing, and such as to evoke the energies of its inhabitants; the changes are so gradual that it would be exceedingly healthy were it not that the want of sanitary arrangements, the filth and absence of drains, give rise to miasma, which, if not the irritating, is, at all events, a predisposing cause of deadly zymotic diseases. The soil, naturally fertile, instead of being, as is the case, periodically parched by droughts, would be regularly visited by rains and snows, were it not that the hills, which might be covered with moisture, producing trees, are bare and barren, every atom of wood, except in the neighbourhood of the temples, and a few orchard trees, being ruthlessly cut for fuel as soon as it grows. Large tracts, too, which might be covered with vines (to which cultivation the climate is peculiarly favourable), as the hills by the Rhine and Moselle, produce nothing but stunted weeds. Rivers which, by a little deepening, might be made highways of commerce and centres of irrigation, wind their way through shallow sands and undrained marshes, carrying their wealth of water to the sea. Noble lakes, which by a little trouble could be made into valuable reservoirs, periodically overflow their banks, and devastate the fields they should fertilise, and choke up the water highways they should keep full and clear. Natural routes, winding through hills of gentle gradients, and of just sufficient altitude to afford good drainage, only requiring a few shovelfuls of the stone that abounds in the neighbourhood to make them into excellent roads, are by neglect utterly impassable at all times by wheeled conveyances, and, after a small shower of snow, even by pack mules.

A little surreptitious washing of a few streams is all the advantage taken of the rich store of gold in the province; the silver mines have been closed, and the same neglect and obstruction are evinced with regard to the less precious, but equally valuable metals, such as tin, lead, iron, and copper. Coal exists all over the province, and at points whence it could be transported with ease to large centres of industry, and to ports in which are anchored many steamers of Chinese and foreign nationality. In a country where thousands starve annually from cold, where every weed and stick is valuable for fuel, the best of fuel lies on the ground with no one to pick it up, while coal imported from China and Japan not only feeds the steamers, but also the furnaces of the native blacksmiths and ironmongers. The fine marble, the granite, the splendid sandstone, to be seen stretching hundreds of feet without a flaw, which might erect magnificent palaces, are only carved into a few tombstones, and picked out to build cottages and pig-styes. An industrious and stalwart population, pre-eminently sober and law-abiding, incapable, it is true, of the larger commercial undertakings, such as railways and steamboat companies, without, also, the high intelligence of our artisans, but peculiarly apt at the smaller branches of trade, and with a fair skill in the ruder arts, are

kept in bondage by ignorance, unrelieved by religious feelings and aspirations; and under the yoke of bad laws and worse administration, have their intelligence stunted and individuality destroyed. Condemned to a state of hand-to-mouth poverty, they enjoy, at the best of times, but a vegetable prosperity, and, on the failure of a single harvest, perish by thousands of starvation.

POPULATION, INDUSTRIES, AND AGRICULTURE OF THE PROVINCE OF TREBIZOND.

Vice-Consul Biliotti, in his report upon the Province of Trebizond, states, in a rough calculation, the population amounts to about 1,000,000 inhabitants, more than four-fifths of whom are Mussulmans. The proportion of the Christians between themselves is one Armenian to three-and-a-half Greeks. The population of the inland districts addict themselves exclusively to agriculture, and are content with producing just enough to satisfy the wants of their families. Many Christians, Greeks especially, emigrate to Russia, where they find more remunerative employment, and return at the end of one or more years. Mussulmans proceed to Constantinople, where they find work as boatmen, porters, &c. On the sea-coast, a seafaring life is the usual avocation of a great part of the population. Black Sea marines are considered first-rate, and mostly man the Turkish navy. They carry on, almost to the exclusion of Russian natives, the coasting trade between this and the Russian coast, and are expert fishermen. The inhabitants of Surmeneh and vicinity are especially engaged in porpoise-fishing; they extend nets at a distance of some miles from the shore, and allow them to remain in the sea for two or three weeks, at the end of which time they often make capital hauls. Porpoise fish is also shot by good marksmen, and yields an abundant supply of oil; in some exceptional cases, as much as 300 lbs. from a single fish. Although it has a strong smell, it was generally used for lamps before the introduction of petroleum, by which it is being gradually superseded.

One of the occupations of the country women, besides assisting in agricultural pursuits, is to spin woollen cloth, which, to the exclusion of cotton stuffs, is used by both sexes for outer garments. They also manufacture, more especially in the seashore districts, linen stuffs, used for shirts; but cotton goods are imported from Great Britain. Rizeh linen is held in great repute all over Turkey. It is so fine, that a piece of the first quality, containing usually 45 picks (27 yards), of a width of two feet, does not weigh more than seven ounces. This quality is sold at £15 a piece. In some parts of the interior, and in Trebizond, since two or three years, cotton twist from Great Britain is employed in manufacturing striped stuffs (Manoossa), which are in great use among Orientals. They were formerly fabricated at Aleppo, and forwarded to other parts of Anatolia. The natives prefer these home-spun to similar articles imported from Europe, which, though cheaper, do not wear so well. Printing head-dress handkerchiefs is also an important branch of industry among Turkish women in towns. They use muslins of British manufacture. The inhabitants of this province are expert smiths. They manufacture capital cutlasses, fire-arms, and locks of an ingenious system; also silver and gold ornaments, some of them of a peculiar style. These industries have probably come down by tradition, the inhabitants of Pontus having been, since remote times, skilful men in metals. It is much to be regretted that a country so rich in mineral ores, and whose present inhabitants addict themselves to the industry of smiths on a scale of some importance, should be supplied with metals from without. Nothing is done to promote the working of mines, but much to prevent those who venture on similar enterprises from carrying out their projects. A gentleman who discovered, four or five years ago, a mine of manganese at Fatza, has hitherto been unable to obtain a concession or a permission to export, in the meantime, the mineral ore is ready for embarkation. With regard to the agriculture of the province, Vice-Consul Biliotti states that Indian corn is grown especially in the districts bordering the sea-shore; the soil here is more adapted to its cultivation than to that of other cereals, and the natives are so accustomed to live on bread made with Indian corn-flour, that if it were even sold at a higher price than wheat flour, they would give the preference to the former. Beans are sown together with Indian corn, whose stalks serve as supports to the flexible plant of the haricot bean, which is the kind produced. The combined yield of these is more remunerative than that of wheat. The agricultural classes of the sea-coast districts mainly live on Indian corn and beans. The pellagon, which is the consequence of an uninterrupted diet on Indian corn, is a disorder not unknown, but it is not so severe nor so common as in Northern Italy. Wheat and barley are grown in all the districts of this province, but to a greater extent in the southern ones, where the climate is not propitious to the culture of Indian corn and beans. Oats are produced in sufficient quantities for exportation only in the in the district of Samsoon; the yield in the other districts is trifling. The swamped low lands in the vicinity of Tireboli, Ordoo, Oonieh, Kerassund, Niksar, and Tcharchambar, are used as rice fields, and produce sufficient quantities for the wants of the populations of this coast, and also for exportation, but the quality is inferior. Flax and hemp are important products of the sea coast districts between Atino and Perchembeh, but in particular of those of Oonieh and Thermé. A great part of the hemp required at the Government arsenal at Constantinople is furnished by these localities. Tobacco is one of the principal products of the district of Samsoon, and is of good quality. The average yield is 7,000,000 lbs. a year. Hazel nuts constitute the great riches of the coast districts, extending from Athina to a little to the west of Kerassund, and particularly of the latter place, Tireboli, Ordoo, Keureli, Yomurah, and Surmeneh. The best qualities are those of Kerassund and Tireboli. Walnuts are far from having the importance of hazel nuts; they are produced in small quantities in the districts of Trebizond and Lazistan. Many splendid trees have been cut down within the last few years, to satisfy the demands of speculators in walnut knobs (*loupes*). The name of tea has been given to a shrub discovered one or two years ago in the forest of Lazistan, somewhat resembling the tea plant. Though its leaf is far from possessing the aromatic quality of real tea, it is used, to some extent, by the natives, and its gathering would have been carried on on a large scale were it not for the exaggerated forest dues of 20 per cent. claimed by Government. Bees are reared on a somewhat large scale in this province, but the honey produced on the coast is unfit for food. Those who partake of it are taken with giddiness, vomiting, and intoxication, exactly as, on their tasting honey, Xenophon's soldiers suffered in his memorable retreat. There are even cases of death reported. It is presumed that the poisonous substances contained in this honey is gathered by the bees in flower of the *Datura stramonium*, which grows in the abundance on this coast. Beehives are, therefore, only remunerative in wax. However, the honey produced in the highlands is innocuous, and of superior quality. The cultivation of the potato, which was introduced some twenty years ago, has not yet extended beyond the districts of Trebizond, Platana, Yomurah, and Matchka, but it tends every year to become of more general use. Amongst other vegetables, the most common are mallows, onions, garlics, leeks, and cabbages, though all the kinds known in Turkey are more or less grown here. Amongst fruits, pears, apples,

plums, and cherries, hold the first rank. Grapes, from which wine is made in some localities, are produced in the lowlands, and are good. There are no other fruits which require mention on account of quantity or quality, except melons.

The breed of native oxen and mules is very poor, that of horses tolerable, while that of sheep and goats is good. However, the flocks of the latter in this province are not numerous; most of the sheep and goats slaughtered for food on the sea-coast towns are conveyed here from beyond the limits of the villayet. In places particularly adapted for them, buffaloes are found, but they cannot live everywhere, and most of those imported by the Abkhazians at the time of their immigration, as well as goats of a particular breed, have perished. The horses of the caravans are strong, though not fine, but Persian mules are first-rate animals in all respects. Camels seen in this quarter do not appear to belong to a very superior breed. Pigs are unknown, and native Christians have as much aversion as Mussulmans, to feed on these animals.

ON THE MANUFACTURE OF BOSCH BUTTER IN THE UNITED STATES.

Of late years, the trade in this article, both as a manufacture and export, has largely increased in the United States, and in the opinion of an American *savant*, it has already become a serious competitor in the market for anything but the finest class of butter. From the correspondence recently published and presented to Parliament, it will be seen that several large firms in New York have undertaken the manufacture of oleo-margarine, the most important establishment being that of the Commercial Manufacturing Company, who also have, it is stated, a branch house in London. This company has the exclusive right of manufacture in the State of New York, under a licence granted to them by the American Dairy Company, which possesses the sole right from Monsieur Mège, of France, the inventor and patentee of the process, to issue such licences for the United States. Besides the factories in work in New York, the following are also in operation:—Two in Pennsylvania; two at Baltimore, Maryland; one at Chicago, Illinois; one at Cincinnati, Ohio; and one at New Haven, Connecticut. The business of these establishments, however, is of a very limited character in comparison with that of the Commercial Manufacturing Company, which commenced operations in 1876. As much as 500,000 lbs. of fat per week have been converted by them into oleo-margarine butter. This rate of production has not always been maintained, for when the retail price of genuine butter falls below 23 cents per pound, it does not pay to manufacture the imitation article. During the last two years, the quantity of fat manufactured into oleo-margarine butter by the last-named company has been, it is stated on trustworthy authority, about 200,000 lbs. per week, yielding 80,000 lbs. of oil and butter. Of this about 75 per cent., or 60,000 lbs. per week, was the oil product, "oleo-margarine," all of which was exported in barrels or tierces, for the most part under that name, but sometimes as "butter-fat," or simply as "oil." Therefore, it will be seen that this company exports yearly about 3,000,000 lbs., a quantity which is nearly equalled by outside manufacturers, so that the total quantity of oleo-margarine exported from the United States may be estimated in round numbers at about 6,000,000 lbs. yearly.

It is the opinion of her Majesty's Consul at New York that the shipments of the outside manufacturers are made to Hamburg, Bremen, and other German ports, and also to Rotterdam, but none to the United Kingdom. In the case of the Commercial Manufacturing Company, their shipments are chiefly to Rotterdam, whence the oil is sent to a place called "Oss," and other towns in Holland, where it is mixed with a certain proportion of milk (to give it a butter flavour) and colouring ingredients, to perfect its resemblance to butter, and is there churned and converted into butterine. It is then re-shipped to France and England, but under what designation it reaches this country it is impossible to ascertain. During the winter months, both the oil and butterine are exported from New York, the latter being cheaply shipped to the United Kingdom under the designation of "butterine," "oleo-margarine," "butter-fat," "butter-grease," or, possibly, butter itself. The manufacture of this article being almost a monopoly, and the exports being in the hands of one or two firms—who are naturally interested in disposing of their substitute as the genuine article—it is not easy to ascertain if shipments of it are not sometimes made as genuine butter. It is usually packed in half tubs, or firkins, in precisely the same way as butter, and the tubs are enclosed in crates, to protect them from injury on the voyage. It is also made up into 1 lb. "pats," covered by muslin or thin cotton wrappers, stamped like genuine butter, and packed in boxes for shipment.

According to the *New York Commercial Advertiser*, of February 2nd, 1878, there are numerous factories of oleo-margarine butter in France, Holland, Germany, England, and Ireland, as well as in the United States, employing many thousands of men, and involving investments of capital amounting to millions of dollars. In Vienna, one establishment alone employs 500 men, and its annual production of butter is equivalent to that of 30,000 cows.

In a report to the *American Dairyman*, of June 6th, 1878, Mr. John Michels, a well-known microscopist of New York, states that he made a microscopic examination of oleo-margarine, and gives it as his opinion that, during the whole process of manufacture from the fat of animals, this fat is never submitted to a higher temperature than 120° Fahr.; the fat oils, therefore, being merely liquified, or set free, and manipulated so as to have the general appearance of butter, are virtually still in a raw state when offered for consumption. It follows that germs of disease, (or their equivalent morbid secretions), and embryos of parasites are thus liable to be transferred in a living condition into the systems of those who make use of this substance.

The prospectus of the companies engaged in the manufacture of oleo-margarine, states that the caul fat of the ox only is used; but Mr. Michels, in his report, affirms that the refuse fat of, at least, one pork packing establishment in New York is used, and as the trade increases, fat of every description will probably be offered for sale, and even that from the carcases of deseased animals may be purchased, unwittingly it is true, by the manufacturers.

Professor Mott, also of New York, differs entirely from Mr. Michels, and after having made a microscopic examination of oleo-margarine, comes to the conclusion that "as made by the Mège patent, he sees no reason why it should not be as wholesome and nutritious as cream butter, and will so believe unless its actual use demonstrates to the contrary," and instead of finding, as Mr. Michels reports, oleo-margarine consisting of "crystals and tissues of animals, with fragments and cells of a suspicious character," discovers, on the contrary, that it consists of "exceedingly clear and beautiful oil globules," the same as in the purest natural butter.

Mr. Michels' report, however, has been substantially confirmed by many eminent microscopists of the United States, and his view of the case taken in preference to that of Mr. Henry Mott, who is the chemist for one of the large grease factories.

Admitting the well-known fact that oleo-margarine must be rendered from animal fat at the lowest practicable temperature, in order that it shall be devoid of the disagreeable odour and flavour which would otherwise inevitably attach to it, as a consequence, this much

vaunted product of caul fat is accordingly liable to contain any living germs which may have been in the animal to which the fat originally belonged.

NOTES ON BOOKS.

The Engineer's Valuing Assistant; being a Practical Treatise on the Valuation of Collieries and other Mines. By H. D. Hoskold, with an introductory note by Peter Gray. London (Longmans).

This work is divided into four parts:—1, contains remarks upon the valuation of mineral property and matters connected therewith; 2, observations on the construction of tables of values, with rules and formulæ; 3, practical examples in valuing colleries, iron, and other mines, royalties, leaseholds, freeholds, life-interests, &c.; 4, sources for redemption of capital, remarks on foreign and home mining. The whole is completed by a series of eighteen tables, some of them giving at sight the years' purchase for any rate of interest up to 25 per cent., and redeeming capital at rates of $2\frac{1}{2}$, 3, $3\frac{1}{2}$, and 4 per cent., of which the author writes, "In past years, when I was extensively engaged in valuing coal and other mines, the labour connected with the necessary and frequent calculation, involving the use of rules derived from first principles, became so tedious, that I determined once for all to prepare full and complete sets of tables required to be employed in valuation as labour savers."

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A. Professor A. W. Williamson, F.R.S., will preside.

April 14.—"The History and Art of Bookbinding." By Henry B. Wheatley, F.S.A., Assistant Secretary of the Society. Lord Alfred S. Churchill, Chairman of the Council, will preside.

April 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt. Sir Coutts Lindsay, Bart., will preside.

April 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By Thomas Fletcher.

May 5.—"The last Forty Years of Agricultural Experience." By John C. Morton. James Caird, C.B., F.R.S., will preside.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Ferriere de La Couperie.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

April 6.—"Art in Japan." By C. Pfoundes.

April 27.—"Iceland and its Resources." By C. G. W. Lock.

May 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

April 8.—"Recent Improvements in Benzine Colours." By F. J. Friswell, F.C.S.

April 22.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course will be by R. W. Edis, F.S.A., on "Art Decoration and Furniture," and will consist of six lectures.

Lecture I.—April 5.

Introductory.—Decoration and Furniture.—Influence of schools of art on design. Fashion in Decoration and Furniture. Modern rooms. Truth, fitness, and beauty in decoration. Use and suitability in furniture. Moral influence. Artistic furniture not necessarily costly. Types of ancient furniture.

Lecture II.—April 12.

Floor, Wall, and Ceiling Decoration.—Mosaics. Tiles. Parquetry. External painting. Tapestry and stuff hangings. Wall papers. Various types of wall and ceiling decoration. Distemper. Stencil work. Figure decoration.

Lecture III.—April 19.

Furniture.—Ancient and modern. General. Constructive furniture: mantel-pieces, fireplaces, fenders, closets, lavatories, window-seats.

Lecture IV.—April 26.

The Entrance-hall, Staircase, Dining-room, and Library.—General treatment. Division of wall spaces. Examples of treatment. Decoration and furnishing.

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

MEETINGS FOR THE ENSUING WEEK.

Thursday, April 1st—Chemical, Burlington-house, W., 8 p.m. 1. Dr. Stenhouse and Mr. C. E. Groves, "β Orcinol." 2. Mr. R. W. Atkinson, "Preliminary Note on the Action of the New Diastase, Eurotin, on Starch." 3. Mr. Lewis T. Wright, "Note on the Products of Combustion of Coal Gas." 4. Mr. H. Chapman Jones, "Polysulphide of Sodium." 5. Mr. Thomas Bayley, "The Reflection from Copper, and the Colorimetric Estimation of Copper." 6. Mr. Watson Smith and Mr. George W. Davies, "Pyrene." 7. Mr. Watson Smith, "Analysis of the Ash of the Wood of Two Varieties of the Eucalyptus."

Geologists' Association, University College, Gower-street, W.C., 8 p.m. Prof. H. G. Seeley, "The Psammolithic Formations, comprising the Formations between the Kimmeridge Clay and the Gault."

Friday, April 2nd...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. B. Haughton, "The Best Route for a Railway to India."

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FRIDAY, APRIL 2, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROGRESS OF PUBLIC HEALTH—ANNUAL CONFERENCE.

Executive Committee:—Lord Alfred Churchill (Chairman of Council), F. A. Abel, C.B., F.R.S., Sir Henry Cole, K.C.B., C. N. Cresswell, Col. Sir E. Du Cane, K.C.B., Major-General Fred. Cotton, R.E., C.S.I., Capt. Douglas Galton, C.B., F.R.S., T. W. Keates, the Right Hon. James Stansfeld, M.P., Dr. Voelcker, F.R.S.

In consequence of the general election, it has been considered advisable to fix the date for the Society's Annual Conference somewhat later than was originally intended, or than has been the case in former years. It will, therefore, be held in the beginning of June. The precise date will be hereafter announced.

As at the previous Conferences, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, will be in the chair.

It has been thought well that an attempt should be made to formulate and bring together the various resolutions which have been passed, and the various opinions which have been generally agreed to in former years. With this view, a programme of subjects for discussion has been drawn up by the Executive Committee, and will be submitted to the Conference. The following are the subjects included in the programme:—

1. The development of Local Government administration, especially by the constitution of County Boards.

2. The extension of the powers of the local authorities of urban and rural sanitary districts. Amendments in the Public Health Act.

3. Sanitary inspection and classification of dwellings.

4. Amendments in the Rivers Pollution Prevention Act.

5. The advisability of strengthening the administrative organisation of the Local Government Board. Local Government Board Administration Areas.

6. Further suggestions by sanitary authorities.

The detailed programme will be issued shortly. Copies can be obtained, when ready, from the Secretary of the Society, by any person who applies. The programme will also be issued to sanitary authorities throughout the kingdom.

It is not proposed to make any attempt to procure papers which may be read and discussed; but the Committee will be glad to receive any communications containing fresh information, or giving accounts of progress made since the last Conference. Such communications, if approved by the Committee, will be printed and circulated at the Conference, but it is probable that time will not admit of any discussion being taken upon them.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1880, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the de-

velopment of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For.Memb.R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

The Council invite members of the Society to forward to the Secretary, on or before the 24th of April, the names of such men of high distinction as they may think worthy of this honour.

APPENDIX TO MR. A. J. ELLIS'S PAPER ON THE HISTORY OF MUSICAL PITCH.

On page 299, col. 1, and page 300, col. 1, of the *Journal* for 5 March, 1880, I stated that some important measurements by Prof. Mayer, of the Stevens Institute, Hoboken, New Jersey, United States, had not reached me in time to insert in their proper place in my paper, and that I should communicate them subsequently to the Society. They have now reached me, and I fulfil my promise. At the same time I take this opportunity of correcting a few misprints, and adding some information which also for the most part reached me since my paper was printed.

Corrections.

Page 293, col. 2, footnote, among organists, *for* Mrs. Stirling *read* Mrs. Stirling (Bridge.)

Page 293, col. 1, footnote, to "*organists*," *add* W. Rea, late of Tynedock Church, Newcastle-upon-Tyne; and to "*musicians*," *add* Ch. Chambers, Mus.B., Newcastle-upon-Tyne.

Page 295, col. 1, lines 15 and 16, *for* November, 1869, *read* November, 1852.

Page 297, col. 2, last line, the references should be to (1) A 442·5 and (1) A 448·0.

Page 300, col. 1, in lower table, *for* Feydean Ellis 423·09, *read* Feydeau Ellis 423·01.

Page 301, col. 2, Table, *for* M_3, M_4, M_8, Re_8, Mi_8, *read* Mi_3, Mi_4, Ut_5, Re_5, Mi_5.

Page 303, col. 1, easy higher limit, actual, *for* 1 SG 704 *read* 1 SF 704.

Page 304, col. 1, footnote, line 17, *for* clarinet, *read* oboe.

Page 305, col. 1, Table, line 2·7, *for* 1820-26, *read* 1828.

Page 306, col. 2, lines 9 and 8 from bottom, *read* Salomon de Caus's A 396·4.

Page 314, col. 3, under "Fifthly," *for* 1876, *read* 1816.

Page 315, col. 1, line 18 from bottom, *for* by giving a tone higher, *read* by going a Tone higher.

Page 318, col. 1, line 6 from bottom, *dele* (1681-99), and in following line after the word "composer," *insert* (1681-1764).

Page 319, col. 1, under A 419·9, transpose the second and third lines.

Page 319, col. 2, line 13 from bottom, *for* Tchudi, *read* Tschudi.

Page 322, under A 427·8, line 5, *for* calculations, *read* calculating.

Page 325, col. 2, under (1) A 440·2, line 1, *for* AIC, *read* MC.

Page 329, col. 1, under EA 452·5, line 3, 4, and 5, *read*, tuned during that period by Mr. J. Black, of Broadwood's, approved by Sir Michael Costa, and recorded by Mr. Hipkins.

Page 331, col. 1, line 31, for this organ, *read* this last organ.

Page 335, col. 1. 2. *Old Forks*, the reference to the Marquis d'Aligre's should be A 439·4.

No other error will occasion any trouble.

1. *Introduction of Equal Temperament.* (App. to Art 4, p. 294, col. 2.)—In the "Mémoires concernant l'histoire, les sciences, les arts, les mœurs, les usages, &c., des Chinois, par les Missionnaires de Pe-kin," 1780, Paris, vol. 6, edited by the Abbé Rossier, author of a "Mémoire sur la musique des anciens," there is an approximate ancient calculation of the lengths of the pipes for the twelve *lu*, or notes of the scale (p. 105), which shows the use of equal temperament; and in part 2, fig. 18, the same are calculated out fully and accurately by a modern Chinese. It must be remembered, however, that the Chinese did not employ harmony. In Europe, neither Zarlino, 1562, nor Salinas, 1577, mentions equal temperament. But Mersenne, 1636, does, and gives the numbers correctly ("Harm. Univ., Liv. 2, prop. xi., p. 132), and adds (*ibid* liv. 3, prop. xii., "Des Genres de la Musique") that equal temperament "est le plus usité et le plus commode, et que tous les praticiens avouent que la division de l'Octave en 12 démitons leur est plus facile pour toucher les instruments." Of the ease there is no doubt, of the customariness corroboration is required. Mersenne gives also the meantone temperament, and deduces all his systems from the relations of just intonation, taking them bodily from Salinas. Werckmeister recommended equal temperament, and Schnitger attemped to carry it out in North Germany, 1688 (see A 489·2). This was more than a merely isolated attempt, but it does not seem to have spread to other countries. Dr. Robert Smith, 1759, must have actually heard equal temperament, or he could not have spoken of it as "that inharmonious system of 12 hemi-

tones," producing a "harmony extremely coarse and disagreeable" ("Harmonics," 2nd ed., pp. 166-7). Dom Bédos, 1766, must also have heard it when he rejected it as "harsh and less harmonious than the old tuning" (see A 376·6).

As regards the recent English introduction of equal temperament, Mr. James Broadwood, in the "New Monthly Magazine" for 1st September, 1811, proposed it, and gave the error of the Fifths as one-fortieth of a semitone, which was to him the smallest sensible interval. On 1st October, 1811, Mr. John Farey, sen., showed that this was too much (it is much more nearly one-fiftieth of a semitone, or accurately S 0·01954), and referred to the article Equal Temperament in Rees's Cyclopædia, whereupon, on 1 Nov., Mr. James Broadwood says, that he gave merely a practical method of producing equal temperament, "from its being in most general use, and because of the various systems it has been pronounced the best deserving that appellation by Haydn, Mozart, and other masters of harmony" (unfortunately he adds no references), and concludes by saying that he is "still of opinion . . . that mathematical speculations cannot be of any practical use in directing the tuning hammer." Mr. Hipkins has been at some pains to ascertain how far equal temperament was general at that time, and from him I have learnt what follows. Mr. Peppercorn, who tuned originally for the Philharmonic Concerts (see A 423·7, and additions in Appendix, No. 7), was concert-tuner at Broadwood's, and a great favourite of Mr. James Broadwood. His son writes to Mr. Hipkins, that his father "always tuned so that all keys can be played in, and neither he nor I (the son) ever held with making some keys sweet and others sour." Mr. Bailey, however, who succeeded Mr. Peppercorn as concert-tuner, and tuned Mr. James Broadwood's own piano at Lyne, his country house, used the meantone temperament to Mr. Hipkins's own knowledge, and no other. Not one of the old tuners Mr. Hipkins knew (and some had been favourite tuners of Mr. James Broadwood), tuned anything like equal temperament. Collard, the Wilkies, Challenger, Seymour, all tuned the meantone temperament, except that, like Arnold Schlick, 1511, they raised the G *sharp* somewhat to mitigate the *wolf* or disagreeable noise resulting from the use of the Fifth E *flat* G *sharp*, in place of E *flat* A *flat*. Hence, even Mr. James Broadwood did not succeed in introducing equal temperament permanently into his own establishment, and all tradition of it died out in his house long ago.

In 1812, Dr. Crotch ("Elements of Musical Composition," pp. 134-5) gives the proper figures for equal temperament, and shows how it arose, and that it made the Fifths too flat, and the major Thirds too sharp, adding "this will render all keys equally imperfect." But he says nothing to recommend it.

1840, Dr. Crotch had his own chamber organ tuned in equal temperament, as I am informed by Mr. E. J. Hopkins, of the Temple Church.

The rest of this history will be found on p. 295, col. 1. (reading 1852 for 1869 in line 16), whence it appears that Equal Temperament for Pianos did not become a trade usage till 1844, and Equal Temperament for Organs, did not become a trade usage till 1854. Hence these are the real dates of the recognition of Equal Temperament as the regular English system of tuning.

2. *Comparison of Scheibler's, McLeod's, and Mayer's Measures.* (Appendix to Arts. 16 and 18, p. 299, col. 1, and p. 300, col. 1.)—The five first forks of the lower table on p. 300, col. 1, were measured for me both by Prof. McLeod, and Prof. Mayer, by their methods described in Arts. 15 and 16, with the greatest care, for which I am much indebted to them. The forks did not return to me from Prof. Mayer, in America, till after the reading of my paper. Before sending them to him I had compared each with several of Scheibler's and my own forks. For Prof. Mayer's method it is necessary to cement with shellac a very light metal point to the end of one prong, in order to scribe the wave-curve, and also to transmit the electric spark which marks the seconds. This additional weight, small as it is, ought to flatten the fork. Hence, after the forks were returned with the points on, I compared them afresh with each of the other forks, to discover the amount of flattening. In the case of three fine large forks this was scarcely sensible, for the Marloye fork, not at all, for the Conservatoire fork, a doubtful V ·02, for the Versailles fork, an equally doubtful V ·04. But the Feydeau fork had lost V ·09, and the Tuileries fork as much as V ·14, owing, I presume, to some imperfection in the material (unhardened steel) of which they are made, for the last fork dies off and becomes faint much sooner than the others, though equally fine to all appearance. I found also that I had not previously taken account of all my measures of the Feydeau fork, and, therefore, correct the mean in the following Table, which compares all the measures at 59° F, corrected for the flattening by the added points.

Name of Fork.	M'Leod.	Ellis.	Mayer.
Conservatoire, 2A	439·55	439·54	439·48
Tuileries, 2A	434·33	434·25	434·26
Feydeau, 2A	423·02	423·01	423·00
Versailles, 2A.....	395·83	395·79	395·77
Marloye, 2C	255·98	255·96	255·98

The extreme closeness of these results, obtained by such entirely different methods, proves indisputably that we can now measure pitch within one-tenth of a vibration in a second, and that my count of Scheibler's forks cannot be wrong to that extent, and hence that my present measures are probably equally correct.

The four forks of Koenig, measured by Prof. M'Leod and myself were not sent to America, but Prof. Mayer had an opportunity of measuring three of Koenig's Ut_3, one of which had been but recently purchased. Prof. M'Leod had also measured two others, and so had I. The following is the result of these nine different measurements.

Koenig's Ut_3. 1) Measured by Prof. M'Leod. His own fork, V 256·31, Prof. Guthrie's two forks, V 256·14 and V 256·17. 2) Measured by Prof. Mayer, three different forks, V 256·38, 256·34, 256·35. 3) Measured by myself, Prof. M'Leod's fork, as above, V 256·30; Dr. Spottiswoode's fork, V 256·23; a copy, made by myself, of Prof. Tyndall's fork before it was injured, frequently

compared with the original, V 256·28. The mean of these 9 measures is V 256·28, which I have assumed as the probable mean value of Ut_3 on page 301, col. 2, Table.

(3.) *Compass of the Voice.* (Appendix to Art. 21, page 303, col. 2).—The following are the limiting notes of "the most sonorous compass of the seven different voices in most choral bodies," according to H. Berlioz ("Modern Instrumentation," Novello's edition, 1856, page 178), where, as it was printed before the French Diapason Normal was introduced, I assume Broadwood's mean pitch, as I did for Randegger. These limits should be contrasted with the inner, outer, and mean limits of my Tables in the text, and will be found wider than the first, but much narrower than the other two.

	From			To	
First Soprano ..	2 C	265·3	....	1 B *flat*	945·4
Second Soprano..	4 B	250·6	....	1 G	795·0
Contralto	4 F	177·1	....	1 E *flat*	631·0
First Tenor	4 C	132·6	....	2 B *flat*	472·7
Second Tenor ..	4 C	132·6	....	2 G	397·5
Barytone or First Bass	8 B *flat*	118·2	....	2 F	354·2
Bass	4 F	88·6	....	2 E *flat*	315·5

Actual usage of composers. Handel, in his early "Acis and Galatea" (see article *Bass* in Grove's Dictionary), wrote a bass song from 8 C *sharp* to 2 A. In the bass parts of his "Messiah," Handel only once gives 8 F 84·5 (in "Lift up your heads"), rarely uses 8 G 94·7, but frequently has 8 A 105·6, and writes up to 2 E 315·9, but not often. In the "Hallelujah Chorus," he takes his sopranos to a long sustained 1 G 757·6, and his solo soprano in "Rejoice greatly," touches only in passing 1 A *flat* 789·8. In the "Seraglio," Osmin's song, "Ah! che voglio trionfare"), Mozart makes a bass sustain 8 D 70·6 for 8 (allegro) bars, and immediately jump up two octaves to 2 D 282·5. In the "Benedictus," of the 12th Mass, Mozart leads a bass voice by a chromatic scale from 4 C 126·3 down to 8 E 75·1, which cannot be escaped. In the "Magic Flute," he makes the "Queen of the Night" sing up to ½ F 135·2. In "Robert le Diable," Meyerbeer once makes Bertram sing to 8 E 83·6 (taking his pitch to have been A 446·2, as is very possible), and in "Dinorah," makes a soprano sustain ½ C 1061·2, which Mad. A. Patti has often been forced to sing at ½ C 1070, and now objects to sing higher than ½ C 1035·6.

(4.) *Violin Resonance.* (Appendix to Art. 26, page 309, col. 2.)—Dr. Huggins thought his Stradivarius violin sounded better at present concert pitch, say A 454. Mr. Healey thought his old violin, supposed to be an Amati, sounded best at about Handel's pitch, or A 422·5. These are the very pitches corresponding to the two maximum resonances observed in the text.

Appendix to Table 1.

(5.) *Russian Court Church.* (Insert on p. 319, col. 1 after A 420·1.) A 421·2, EC 500·9 (MC 503·9, JC 505·4), S 2·24, (Ellis.) 1860, Russia, Imperial Russian Court Church band.—This fork, a copy belonging formerly to Herr Nake, was lent to me by his widow. It was contained in the same box as Stein's fork, A 421·3, and was accidentally overlooked in drawing up Table I.

(6.) *Handel's Fork.* (Appendix to (1) A 422·5, page 319, col. 2, line 17 from bottom.)—Mr. Hipkins thinks that Mr. Reid was mistaken in supposing that the house of Broadwood ever owned Handel's fork. Mr. Hipkins supposes that Mr. Reid's mistake arose from Mr. Clarke having brought Handel's fork to Broadwood's in 1855 to show it, and also from the corresponding pitch of Peppercorn's fork (see Appendix No. 7, to A 423·7), which was in possession of that house.

(7.) *Original Pitch of the Philharmonic Concerts.* (Appendix to A 423·3 and A 423·7, p. 320, col. 2.)—The following is a copy of Mr. Peppercorn's certificate preserved at Messrs. Broadwoods' :—"This is to certify that I, John Peppercorn, tuned for 15 years [1813-1828] at the Philharmonic Concerts, for Messrs. Broadwood and Sons, which is now nearly 30 years since, and that I have the same fork in my possession. It was given to me from the members of the Philharmonic Society, as the Pitch determined and settled by mutual consent. It is half a tone lower than the present Philharmonic Pitch. The Pitch given to me, Sir George Smart being in possession of a fork exactly the same, he always kept me exactly to it. This same Pitch, given to me by the members of the Philharmonic, agrees [with] Handel's Pitch, with the Pitch also of a fork shown to me by the late Mr. Jacobs, organist to the Rev. Rowland Hill's Chapel, which was about 30 years since, and his Father had been master to the Sons of the Clergy, about 70 years before. I was shown a *Mater Dei* Convent Bell, certainly 500 years old, with which this Pitch also agreed, as also with that of most of our Church Bells. 20th March, 1855. (Signed) Jno. Peppercorn. This pitch also agrees with an ancient fork and other forks in the possession of Mr. Black, at Messrs. Broadwood's. [See Table I., A 422·7, 423·6, 427·2, 427·5, 428·4.] The fork, shown at Messrs. Broadwood's as Sir George Smart's present pitch [see A 433] is nearly a quarter of a tone sharper than the one I now have [really S 0·37, more than a quarter of a tone], and certainly was not the pitch made use of at the Philharmonic Concerts when I tuned at them. (Signed) Jno. Peppercorn." With regard to church bells, see Colbacchini's pitch pipes, A 425·2, and Cavedini's fork, A 422·3, both from bell-founders, and both used to determine the pitch of bells. Mr. Herrmann Smith tells me that Mr. Lewis, the organ builder, found the famous old bell at Lavenham (16½ miles W.N.W. of Ipswich), date 1625, meant to be and called D, to be a very sharp C *sharp*, Philharmonic fork, whatever that may be. If we take it to be Sir G. Smart's pitch, A 433·2, it would be higher than EC *sharp* 544; if we take it at A 444·2 (which see), it would be higher than EC *sharp* 559·7. Now, Handel's fork gives MD 565, so that the probability is the D is a Handel's D.

(8.) *The Jordans's Maidstone Organ.* (Insert on p. 325, col. 1, after A 437·4). *(2) MA 437·4 (EA 440, JA 436), C 523·3, S 2·89. (Streatfield and Ellis.) 1744, Maidstone, old parish church. This organ was built by the Jordans, and in 1878 had this pitch, and was in mean tone temperament. On 25 March 1880, while the pipes were lying open, having been just returned by Lewis, who was rebuilding the organ and putting it in equal temperament, at his own pitch (see (4) A 441). I examined the marks on many pipes, and could find no sign of old shifting. The stopped diapason, least likely to be altered, but easily tunable by its long ears within the limits A 437 and A 442, was apparently quite unaltered, and I found the genuine old markings of the peculiar German *d* and *d* sharp, on the pipes which bore also Lewis's marks of D and D *sharp*. So there seems to be no doubt that the pitch has been preserved to this day. But as the Jordans also used the sharp pitch A 474·1 (which see) at St. George's, Botolph-lane, it follows that the Jordans as well as Bernard Schmidt, used two pitches, or made both A foot and B *flat* foot organs, corresponding to a church and a chamber pitch.

(9.) *Temple Church Organ.* (Insert after *A 444·3, page

327, col. 1), *(2) **444·3** measured, and also B *flat* 471·4, B 498·6, C 529 measured. (Ellis.) 1880, London, Temple Church organ, after it had been repaired and resettled in 1879, by Messrs. Forster and Andrews, of Hull.—The original organ was built by B. Schmidt probably at A 441·7, and was flattened by Mr. C. A. Bishop to A 433·2 (see notes on (1) A 422·5); it was afterwards reconstructed by Schulze in 1859, and he made the pitch so sharp that Messrs. Forster and Andrews had to shift the pipes a semitone, to bring it to this pitch. This would imply that Schulze's pitch was A 470·7, which is hardly likely (see A 452·8 in Appendix No. 11). The pipes were probably adjusted after shifting. To depress a quarter of a tone was found too little, as Mr. Forster said. Hence, after depressing a semitone, the pipes were possibly cut to sharpen them. The whole of Schulze's Hohlflöte stop as sent from Germany was too sharp, and had to be accommodated afterwards. The actual pitches measured above are not exactly in tune. Starting from A we should have had A 444·3 EB *flat* 470·7, EB 498·7, EC 528·4, and starting from measured C 529, we should have, EB 499·3, EB *flat* 471·3, EA 444·8.

(10.) *Belgian Army Military Instrument Pitch.* (Appendix to A 451, p. 329, col. 1).—M. Victor Mahillon has had the kindness to send me the following, which reached me on 29 March. Before 16 December 1874, numerous standards for military music were in use in Belgium, occasioning extreme embarassment to manufacturers. The ministry, therefore, sent the several forks to M. Mahillon for the purpose of selecting the mean, and he, not having a tonometer, sent the selected mean to M. Koenig, in Paris, to measure, and to construct from it a large standard fork for future use. On the ministry being informed that the mean pitch was VS 902 = V 451, a ministerial decree was issued, dated as above, fixing this as the standard determined by Koenig's fork. Hence, as the copy I saw was A 451·7, either Koenig's measurement was slightly incorrect (which is very probable, see measurements of his Ut_3 in No. (2) in this Appendix), or the large fork he made rose in pitch after tuning (which is very probable), or both (which is still more probable). From this standard M. Mahillon tuned Dr. Stone's copies by ear, but he sometimes makes copies by the optical process of Lissajous. That process was not used to determine the pitch, which was due to Koenig's measurements. Subsequently to the settlement of this standard, M. Dunkler (d. 1878), bandmaster of the regiments of Grenadiers and Chasseurs in Holland, succeeded in establishing A 451 as the Dutch standard for military music also. On 21 Dec. 1875, a Commission was appointed by Royal decree in Belgium to examine the possibility of establishing a uniform pitch in Belgium. Mons. F. A. Gevaert, Director of the Royal Conservatoire at Brussels, was president, and Mons. V. Mahillon secretary. The Commission recommended the adoption of the French Diapason Normal for military music as well as for the Conservatoire. This recommendation remains pigeon-holed on account of the great expense which the alteration of all military bands would entail, and hence there is at present no uniform Belgian standard.

(11.) *Schulze's Tynedock Organ.* (Insert in Table I., after A 452·5, page 329, col. 1). EA **452·8** [MA 450·2, JA 448·8) C 538·5, S 3·50. (Chambers and Ellis.) 1880 (date of measurement), Tynedock Church Organ at Newcastle-on-Tyne, one of the finest built by Schulze in England, from a fork tuned to the open diapason expressly for me by Mr. Charles Chambers, Mus. B. This is practically in the mean Philharmonic pitch, A 452·5. Mr. Rea, formerly organist, found it best to transpose most music by a semitone, and therefore play at A 427·4, that is, practically at the pitch of Harris's organ, St. Nicholas Church, also at Newcastle, see A 428·7. For a similar pitch of Schulze's, see Temple Church Organ, in Appendix, No. 9.

(12.) *Barking Organ.* (Appendix to A 474·1, page 331, col. 2.) This organ (see (2) A 439·5) was probably one of these sharp A foot organs. Both B. Schmidt and Jordans, and hence probably other builders built both A foot and B *flat* foot organs. For Schmidt, see (1) A 441·7, in Table I., for the Jordans', see Maidstone organ, in Appendix, No. 8.

TECHNICAL EDUCATION.

On the 10th of last March the second annual meeting of the governors of the City and Guilds of London Institute for the advancement of Technical Education was held; and at this meeting the Council of the Institute presented a report showing what the course of action had been since the first constitution of the Institute a year previously.

Those who have, during the last few years, watched the action of the City companies in reference to Technical Education, will remember that in 1877 a general committee of certain of the livery companies published a report, suggesting the line of action which might best be taken by the Companies in carrying out the objects they had in view. This report was based upon reports obtained by the committee from various educational experts, and it suggested, as one of the principal objects of the associated guilds, the establishment of a Central Institution in some convenient locality in London, wherein advanced instruction in technical science could be given. The capital outlay for this building was estimated at about £35,000, and the annual expense of the Central Institution at about £10,000. The report also recommended that an additional sum of £10,000 per annum should be devoted towards the establishment of trade schools and other purposes connected with Technical Education. Appended to this report was a form of constitution for an association of the livery companies and the Corporation of London. As a result, many of the livery companies accepted the report, and agreed to subscribe from their funds; and the City and Guilds of London Institute was provisionally constituted in November, 1878.

The first step taken by the Institute was to request their executive committee to prepare suggestions as to the best means of carrying into effect the recommendations made in the report referred to above. Accordingly the executive committee brought up, in February, 1879, a report embodying such suggestions, which was approved at the general meeting of the Institute in March of that same year.

The subjects dealt with in that report were arranged in the following order:—

1. The foundation of a Central Institute for Technical Education.
2. The establishment of, or assistance to, trade schools in London and the provinces.
3. Technological Examinations.
4. Grants in aid of existing institutions.

In the report which has just been issued, the committee of the Institute follows the same arrangement of subjects.

The account given of the negotiations between the Institute and the Commissioners of 1851, with the view of obtaining a site on the property at South Kensington, has already been published in various ways; and must be familiar to those in-

terested in the matter. A summary of the proceedings is given, and also an account of the steps which led the committee of the Institute to consider the desirability of purchasing Mr. Albert Grant's house at Kensington, and the further reasons which led to the abandonment of this scheme. The proposals in this latter direction having been given up, the committee of the Institute recurred to the original idea of obtaining a site through the assistance of the Commissioners of 1851. One of the objections urged on the part of the Commissioners had been that the Institute, as provisionally constituted, did not contain amongst its members any of the acknowledged representatives of science in the country, and this objection seems to have carried considerable weight with the committee, for it had the effect of inducing them to propose and carry a motion that there should be added to the council and committees of the Institute the Presidents of the Royal Society, the Institution of Civil Engineers, and the Chemical Society, and the Chairman of the Council of the Society of Arts. Having thus disposed of the only objection which seems, in the opinion of the committee of the Institute, to have been of very great weight, the committee requested the chairman of their council, their own chairman, and the treasurer of the Institute, these three gentlemen being respectively Lord Selborne, Mr. F. J. Bramwell, F.R.S., and Sir Sidney H. Waterlow, to address a formal application to H.R.H. the Prince of Wales, as the President of the 1851 Commissioners. The writers of this letter stated that the Institute would be willing to provide a sum of £50,000 for the erection of a building for a Central Institution wherein Technical Education of a high character should be given to intending teachers in technological schools, manufacturers, foremen, and workmen. They further stated that the Institute would make an annual grant of not less than £5,000 in excess of any fees, for the working and maintenance of the Institution, on condition that the Commissioners would grant the Institute the lease of a plot of land on their estate for 999 years at a peppercorn rent. The writers went on to state that the £50,000 promised was already secured, and that the existing annual subscriptions to the Institution were more than sufficient to provide the £5,000 required as a minimum annual grant. At the time when the report was issued, a formal answer had not been received to this letter; but it has since been announced that the proposals of the Institution have been accepted, and that the Commissioners of 1851 have definitely promised to grant a free site in South Kensington on the terms proposed by the Institution, the only point to be settled being, it is understood, the precise locality. There seems, therefore, to be little doubt that a very few years more will see the establishment of the great Central Institution for Technical Education, which London has been so long expecting.

The next matter touched upon in the report refers to the establishment of what may be considered as trade schools in London. Instead of establishing any entirely new schools, the Institution availed themselves of two already existing—the Middle Class School in Cowper-street, Finsbury, and the Lambeth School of Art. Arrangements were made with the authorities of the Cowper-street school that accommodation should be provided in the school buildings for technical classes, and also that a building site on the ground of the school should be granted at a certain rent, the Institution undertaking to erect a laboratory or laboratories thereon. Classes were started in two departments—one in Applied Chemistry, and one in Applied Physics and Mechanics, Dr. Armstrong being engaged as lecturer for the chemical classes, and Professor Ayrton for those in physics. After an inaugural lecture, courses of lectures were commenced in "The Practical Applications of Electricity and Magnetism" and "The First Principles of Chemistry." These courses were concluded previous to Christmas, and attracted altogether 105 students. Since Christmas similar courses have been given on "The Principles of Machines," and on "The Chemistry of the more Important Non-Metals." Practical classes for instruction in chemistry and physics have also been opened. The attendances since Christmas have been 111 altogether. The Institute have now under consideration the erection of larger buildings, including chemical and physical laboratories, lecture rooms, &c.; with perhaps similar accommodation for mechanics; and it appears that the Council of the Cowper-street school is willing to provide a larger site than that originally agreed upon. The Institute has set aside £5,000 for these buildings, and this has been largely supplemented by a grant of £10,000 from the Drapers' Company, conditional upon the total being raised to £20,000 by the Institute or by other contributing companies. There thus seems every prospect that, in addition to the Central Institute at South Kensington, there will be, in the course of a year or two, a large Technical School in North London. The fact of this being within the limits of the City itself is considered to meet in some degree the slight opposition which had been raised to the erection of he great Technical College on a site outside its boundaries.

It was understood that Applied Science was to be cared for at Cowper-street, and that the applications of Art to Industry were to be specially developed through the assistance of the Lambeth Art School. Although it was originally proposed merely to extend the operations of that school, as the scheme developed, it was found desirable to establish what is to a great extent an entirely independent Institution. Such an Institution has been established in two houses in Kennington-park-road, which have, by alterations and by buildings erected on the gardens behind them, been rendered suitable for the purpose. Instruction is now being given, both to male and female students, in wood carving, modelling for pottery, architectural decorations, metal work, carving, bronze casting, die-sinking, and cameo cutting.

The next portion of the report is devoted to the Technical Examinations, transferred last year by the Society of Arts to the care of the City Institute. As regards these, the results of last year's examinations have already been published in the *Journal* (August 15, 1879), as has also a notice as to the modifications which were introduced in the original programme of the Society of Arts by the committee of the Institute, September 26, 1879. It may be sufficient to say that the 16 subjects in

which the Society of Arts held examinations have been increased to 32; 63 teachers of the various subjects have been registered in different parts of the country; 56 classes have been established at 30 centres, among these centres being Belfast, Birmingham, Bolton, Crewe, Camborne, Gateshead, Huddersfield, Hulme, Merthyr-Tydvil, Nottingham, Newcastle, Oldham, Penzance, Swansea, and Wigan.

The report then goes on to refer to grants which have been made, or which it is proposed to make, to various existing institutions. Amongst the institutions which it is proposed to assist, but which have not been helped before, the British Horological Institute in Clerkenwell is the one which comes in for the largest share. It is proposed to make a grant of £500 to it, and to give it an annual subscription for three years. The object of this grant is to enable both practical and theoretical classes in watchmaking to be established by the Institute. Should this arrangement be successfully carried out, the experiment of a practical school of watchmaking, such as those at Besançon and elsewhere, which have attracted so much attention on the Continent.

The concluding portion of the report is devoted principally to finance. The income of the Institute for the year 1878 was £11,607; for the year 1879, £12,862. This income is made up by contributions for the following companies, varying in amount from £2,00 down to £50 a year:—Mercers, Drapers, Fishmongers, Goldsmiths, Salters, Ironmongers, Clothworkers, Dyers, Leathersellers, Pewterers, Armourers and Braziers, Carpenters, Cordwainers, Coopers, Plaisterers, Needlemakers.

Five companies give £2,000, two £525, one £500, two £105, one £52 10s., and one £50. The Corporation of London, though represented on the committee and council, has not yet stated its willingness to contribute. The total which the Institute has received since its formation is £25,205, of which it has expended £2,939, leaving a balance of £22,265 available for the purposes of the Institute. Besides this, £30,500 have been promised towards the building fund of the Central Institution by the Fishmongers', Goldsmiths', Clothworkers', and Cordwainers' Companies.

SINGING IN PUBLIC ELEMENTARY SCHOOLS.

The following brief notices of "Singing" in Public Elementary Schools are extracted from the three annual reports of the Education Department, published in the years 1876-7-8. They, apparently, constitute all the information which the public can obtain on the subject of this Singing, which, in 1878, cost £119,129 18s., as returned to Parliament. It is said the amount was even increased in 1879. Seventy-one reports of 1876-7-8 were printed, but probably there were four times that number made in those three years, which may exist in MS., and may give further information on Singing, but they are not accessible. Out of these 71 reports, only 27 inspectors report on "Singing."

Achard, Mr., assistant to Rev. R. Wilde (Hampshire), p. 742.—"In many cases the singing is little more than mere noise. . . . The singing is almost universally taught by ear."

Baldrey, Mr., assistant to Rev. C. J. Robinson (Hertford), 1877, p. 508.—"In 300 departments which attempted singing, and obtained the grant, nearly three-fourths had been taught by ear, about one-seventh by the 'movable do' and tonic sol-fa, and the remainder by 'Hullah,' the last signifying, in most instances, that the theory of the staff had been taught. Few of the schools, when tested, showed much acquaintance with any notation. . . . Few teachers throw any enthusiasm into this branch of their work, but, where a teacher was found fond of singing and with the ability to teach, the results were most pleasing. . . . Teachers might endeavour to make their children readers of music at sight and their schools the nurseries of the choral classes and choirs throughout the land."

Binns, Rev. B. J. (Glamorgan), 1877, p. 415.—"Vocal music is extensively cultivated; part-songs harmoniously and correctly sung; in these, the principles of music have been taught, and the results are of so pleasing a character as to make one wish that such instruction were more general."

Blandford, Rev. J. J. (Midland Counties), 1878, p. 485.—"Eight schools named, 'in which music is taught successfully.' Some teaching from notes is attempted at five other schools named."

Brewer, Mr. W. H., M.A. (part of Lancashire), 1878, p. 513.—"Music is one subject in elementary schools the teaching of which has about it an air of complete unreality." He agrees, with Dr. Hullah, "that songs, as a means of promoting or preparing for a knowledge of music, are absolutely useless, and, indeed, worse than useless, for to no people is it so hard to teach music as to those who have long practised singing by ear."

Brodie, Mr. E. H. (Worcester), 1877, p. 427.—"Mr. Pember tells me the singing is good in about 15 per cent. of the schools, this mark only being given by him where two part-songs and rounds have been taught and the singing has been marked by good time and expression. 'Singing by note' is very rarely taught at all. It is not a paying subject."

Boyle, Mr. R. F. (West Somersetshire), 1876, p. 443.—"The music is, perhaps, the most unsatisfactory part of the work. . . I have known school managers, who enjoy a better ear than myself, leave the room when the singing begins."

Byrne, Rev. J. Rice (Surrey), 1878, p. 523.—"Music is cultivated, except in rare instances, with indifferent success."

Campbell, Rev. W. (Chelsea, Brentford, &c.), 1876, p. 449.—"The singing in schools has very materially deteriorated within the last three years. It is very rarely now that hearty part-singing is to be heard, even in the best schools."

Codd, Mr. H. F. (Devon and Cornwall), 1876, p. 454.—"Singing by ear is very generally taught throughout the district, there being, in fact, only six schools under inspection where it is not attempted. The results are fairly good, and well worth the money which is paid for them; the singing in many of the schools, of course, deserves much higher commendation than this. Singing by note is exceptional. I am not disposed, however, to depreciate the value of mere singing by ear. The children like it; it is valuable as a discipline; is humanising; is, in fact, the one bit of their teaching which appeals to their taste."

Claughton, Mr. H. W. (Suffolk and Essex), 1878, p. 530.—"Singing is taught in all but two schools, and usually with fair success. I consider it to be a useful part of the school course. In a few schools singing is taught from notes."

Cornish, Rev. F. F. (Salford district), 1878, p. 544.—"I feel, however, in reference to this subject (singing), that the requirements are pitched so low that the inspector has not the power of gently screwing up the standard which he possesses with regard to the

other subjects. I have no reason to think that the practice of teaching to sing from notes is extending."

Crossley, Mr. assistant to Rev. J. W. D. Hernaman (West Lambeth), 1878, p. 585.—"In some schools music is exceedingly well taught, but in others very little is attempted beyond the power of singing by ear. . . . Invariably recommends teachers to take up the theory of music."

French Rev. George (Yorkshire), 1878, p. 750.—"In very few schools in my district are the children taught to sing from notes."

Harner, Mr. D., Assistant Inspector to Rev. S. Pryce (Caermarthen and Brecknockshire, 1878), p. 678.—"The number of schools in which the children are taught to sing from notes is, I regret to say, diminishing year by year. . . . Singing by ear throughout the district has somewhat improved."

Kynnersley, Mr. E. M. (Chester district), 1878, p. 610.—"The grant for music is seldom well earned, though I have very seldom been able to refuse to recommend payment. . . . . Most of the time allotted by the time-table to singing is given to learning the words of these songs; the tunes are caught up with great rapidity. Many of the best teachers could teach no more; many of the best inspectors could criticise no higher efforts." See his observations at length.

Lomax, Rev. J. (Stockport district), 1876, p. 636.—"Singing is not generally well taught." . . . "Difficult to determine at what point singing ends and bawling begins." . . . "I think payment for this subject might, without hardship, be limited to singing from notes." . . . "Where good singing prevails, the tone and manners of the children are all that could be desired."

Markheim, Mr. H. W. G. (Northallerton district), 1878, p. 645.—"The inspector, without special musical training, feels himself obliged to recommend the grant as a matter of course in the great majority of cases, while his conscience inwardly protests against the waste of public money on a bad and profitless system of teaching."

Parez, Rev. C. H. (Cumberland, &c.), 1876, p. 527.—"Music is seldom taught by note, less indeed, I think, now than a year or two ago." "The diminution is, perhaps, due to the strain laid upon teachers and scholars by the higher subjects. In a few of my schools, the singing is really good; in some, it is indifferent." "On the whole, the cheering and enlivening effect is beneficial to the children."

Pickard, Rev. H. A. (Oxford district), 1878, p. 666.—"I hope no attention will be paid to the cry for decreasing the payment under Art. 19, A (2). I would rather suggest a small increase of the grant if music is taught by notes, as it ought to be to the higher classes in every school.

Routledge, Rev. C. P., East Kent District, 1878, p. 689.—"Singing remains pretty well in *statu quo*. Singing by ear is a good discipline and cheerful form of recreation, but it is more than doubtful whether it is of any use whatever towards the real cultivation of music."

Sewell, Rev. Capel (Nottingham district), 1877, p. 537, after giving valuable observations, says:—"A spasmodic effort, such as followed the introduction of school singing into the Code, carried most schools beyond the natural level of musical taste and ability for a while; but that effort is exhausted. It would have been further prolonged if your Lordships had been able to insist on singing being satisfactorily taught." And he points out how this may be done through Dr. Hullah's examinations.

Temple, Rev. R. (Welsh district), 1877, p. 565.—"Subject to considerations of economy and official work, it would be a great benefit to accept 'Music from notes' as helping a school to get a grant. . . . I am, I must say, greatly disappointed at the slow progress made in this subject in my district, and I believe such a recognition would have an excellent effect."

Tregarthen, Rev. W. F. (Dorset), 1878, p. 708.—"There is no improvement in the music of the schools in this district. Generally it is only taught 'by ear,' and the singing has deteriorated. In schools where the tonic-sol-fa system is adopted, the singing has also a vigour and interest not to be met with in other places."

Waddington, Mr. Horace, M.A. (Monmouth), 1876, p. 818.—"In singing there is not much progress to report." . . . "Music certainly to a great extent *nascitur non fit*, and it is palpably hopeless for a teacher without ear to teach it to much purpose; but, in such cases, a musical assistant or pupil-teacher may come to the rescue, and much more might be done than has been." He names practical results of the tonic-sol-fa system.

Williams, Mr. T., assistant to Rev. H. Smith (Chester), 1876, p. 569.—"Singing has improved in many of the schools of this district." . . . "Singing from notes is taught in a larger number of schools, and singing with expression is less rare." . . . "Masters and mistresses complain that their pupil-teachers have no opportunity of showing their knowledge of the tonic-sol-fa system at the monthly examinations, such as is afforded to candidates for scholarships and certificates." He commends a local concert arranged by 14 teachers at Birkenhead, by which "a healthy rivalry is established among the schools in union."

Willis, Mr. J. A. (Middlesex), 1878, p. 749.—Gives numbers of departments taught by ear, 122; by old notation, 5; by Mr. Hullah's system, 3; by tonic sol-fa system, 12; and 4 by the "movable do" system.

Watson, Mr. A. M. (East Lancashire), 1878, p. 732.—"Singing is now almost universally in this district taught by 'ear.' I think, certainly, that of late years singing has deteriorated much." . . It would be a great gain, both for inspectors and inspected, of music and singing, for instance, could be taken at a different time from the regular inspection of schools; taken, too, by a skilled examiner."

Hullah, Dr. J. (Inspector of Music in Training Colleges), 1876, p. 730.—"'Singing from notes' is altogether an exceptional subject in elementary schools. Indeed, what has latterly been done for music in schools has rather impeded than furthered its improvement.' . . The 'songs' of the last few years required of scholars are worthless. . . Musical examination in elementary schools would seem to be the natural sequence of musical examination in training schools."

Hullah, Dr. J., 1877, p. 663.—"Neither instruction nor practice, nor anything approaching to it, is at all common in elementary schools; nor will it ever be till such schools are systematically inspected in music by competent persons. . . Singing by rote instead of by note is, from a musical point of view, a mere sham."

Hullah, Dr. J., 1878, p. 841.—"Music is not taught, save in a few exceptional cases, in elementary schools. We have already, I believe, teachers competent and numerous enough to make musical, in a few years, possibly, the entire British Empire, certainly Great Britain and Ireland."

In the Code for 1872, by Article 19A, the sum of 6s. per scholar, according to the average attendance, was to be paid, but might be reduced (Art. 32d) "by one shilling per scholar," "unless 'Vocal Music' forms part of the ordinary course of instruction" (the Right Hon. W. E. Forster, Vice-President). In 1873 the Code presented the same

rule; but in 1874 (Lord Sandon, Vice-President), the words 'unless 'Vocal Music' forms part" were changed into if "Singing" forms part, &c. In his last pamphlet, Dr. Hullah asks, "Why not, then, substitute the teaching of Music for the teaching of songs?" the Code having substituted "Songs" for "Music." (*Vide* p. 23 of Musical Examinations Report of the Society of Arts.)

ELECTRIC LIGHTING.

The Metropolitan Board of Works has just renewed for one year the contract with the Société Générale d'Electricité for lighting the Thames Embankment and Waterloo-bridge by means of the Jablochkoff system of electric lighting. The new contract will expire on the 10th of April, 1881. In view of this circumstance it may be interesting to note briefly the gradual extension of the system, especially as regards its application to public lighting on the Embankment. It may be remembered that the first arrangement was made in October, 1878, by the Metropolitan Board, when they contracted with the Société Générale for lighting, by means of 20 lights, that portion of the Embankment lying between Westminster and Waterloo-bridges. The first public illumination was on the evening of the 13th of December in that year. On the 10th of May, 1879, the lighting of the Embankment was extended eastward from Waterloo-bridge to that of Blackfriars, 20 lights being added to the 20 already working. A further extension of the system was effected on the 10th of October, 1879, when 10 more lights were placed on Waterloo-bridge, thus bringing the total number of public lights in that locality to 50. Since the dates mentioned above—that is, for 15 months for the first series of 20 lights, 10½ months for the second series of 20, and 5½ months for the last series of 10—the whole of the lights have been kept uninterruptedly burning every night, Sundays included, for their alloted time of six hours according to the contract. These facts are worthy of consideration when it is remembered that the plant and machinery were originally laid down for 20 lights only. The subsequent extensions not having been contemplated at the time, no provision whatever was made for them. This has necessitated considerable alterations to the plant each time the additions were made, and those in charge had to do the best they could under the circumstances to meet the case. It is also to be borne in mind that 10 more lights were subsequently obtained from the existing plant, making 60 altogether, the last 10 being those which illuminate the Victoria Station of the Metropolitan District Railway. Since the first contract was entered into, the prices paid by the Board have been considerably reduced. In the first instance the price paid was 6d. per light per hour. Upon the Board increasing the number of lights to 40, the price was reduced to 5d. per light per hour; a further reduction to 3d. being made when the number was increased to 50, and the contract renewed for six months. The lighting is now to be carried out for 2½d. per light per hour, the contract having been extended to one year.

The Jablochkoff system of electric lighting is now in operation not only in public thoroughfares, but in a great variety of works and private establishments as well as in those of public resort. It is also in use in the palace of King Thebaw, of Burmah, at Mandalay, where there are 60 lights, and in the palace of Shah Nasser ed Deen, of Persia, at Teheran, where there are four lights. Prince Agaklan has six in his palace at Bombay, and King Dom Luis I. of Portugal, six in his Royal Palace of Casenëo. Queen Isabella of Spain has also six in the conservatory of her residence in Paris. The Paris Municipal Council has renewed for one year the contract for lighting the Avenue de l'Opéra, and Place du Théâtre Français, and the Sous-Secrétaire d'Etat, at the Ministere des Beaux Arts, has authorised the lighting of the *Salon* at the Palais de l'Industrie in June next on the Jablochkoff system. Altogether the application of this system is quietly extending, and the Metropolitan Board of Works deserve every credit for the part they have taken in developing the question of electric lighting in London.—*Times*.

INDIAN OPIUM IN CHINA.

The following notes on the foreign opium trade in China, are taken from a recently issued report on the foreign trade of Canton, for the year 1878. The quantity of opium imported in foreign vessels showed an increase of 120 per cent. in silver, or considerably over 100 per cent. in gold. The increase was entirely in the Patna kind, which rose from 202 piculs in 1877, to 671 piculs in 1878. The increased importation took place in the last quarter of the year, and was owing to several causes. First, the greater activity of the Foreign Customs Preventive Service, and second, the introduction of a tax on all opium prepared in the prefecture of Kwang-Chow. The right of preparing opium, native and foreign, was sold by the authorities to a contractor for 140,000 dollars per annum, and all opium boilers were obliged to take a boiling license from the contractor, and pay a small tax on all opium prepared. The consequence has been that the smaller boiling shops which derive their supplies chiefly from petty smugglers have been obliged to close their establishments, and the legitimate dealers have had a larger amount of trade thrown into their hands. The new system is very unpopular in Canton, and it is doubtful whether it can be carried out for long. On more than one occasion the troops have been called out to protect the houses and property of those who had offended the populace by urging on the new scheme.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

April 7.—"Buildings for Secondary Educational Purposes." By E. C. Robins, F.S.A., F.R.I.B.A. Professor A. W. Williamson, F.R.S., will preside.

April 14. — "The History and Art of Bookbinding." By Henry B. Wheatley, F.S.A., Assistant Secretary of the Society. George Bullen, F.S.A., Keeper of the Printed Books, British Museum, will preside.

April 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt. Sir Coutts Lindsay, Bart., will preside.

April 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By Thomas Fletcher.

May 5.—"The last Forty Years of Agricultural Experience." By John C. Morton. James Caird, C.B., F.R.S., will preside.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 2.—"The Best Route for a Line of Railway to India." By B. Haughton, C.E. Hyde Clarke, Vice-President, will preside.

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Terrien de La Couperie.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

April 6.—"Art in Japan." By C. Pfoundes.

April 27.—"Iceland and its Resources." By C. G. W. Lock.

May 18.—"The Arts, Manufactures, and Prospects of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

April 8.—"Recent Improvements in Benzine Colours." By F. J. Friswell, F.C.S.

April 22.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course will be by R. W. Edis, F.S.A., on "Art Decoration and Furniture," and will consist of six lectures.

Lecture I.—April 5.

Introductory.—Decoration and Furniture.—Influence of schools of art on design. Fashion in Decoration and Furniture. Modern rooms. Truth, fitness, and beauty in decoration. Use and suitability in furniture. Moral influence. Artistic furniture not necessarily costly. Types of ancient furniture.

Lecture II.—April 12.

Floor, Wall, and Ceiling Decoration.—Mosaics. Tiles. Parquetry. External painting. Tapestry and stuff hangings. Wall papers. Various types of wall and ceiling decoration. Distemper. Stencil work. Figure decoration.

Lecture III.—April 19.

Furniture.—Ancient and modern. General. Constructive furniture: mantel-pieces, fireplaces, fenders, closets, lavatories, window-seats.

Lecture IV.—April 26.

The Entrance-hall, Staircase, Dining-room, and Library.—General treatment. Division of wall spaces. Examples of treatment. Decoration and furnishing.

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and One friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 5th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture I.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Captain Craigie, "Prices of Corn, and the Official Average."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. H. W. Pendred, "Distilling and Hoisting Machinery in Sea-going Vessels."
British Architects, 9, Conduit-street, W., 8 p.m. Mr. John Pollard Seddon, "Suggestions for the Polychromatic Decoration of Various Buildings."
Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m. Mr. James Sorley, "Observations on the Graduation of Mortality Tables, with special reference to the Conditions under which certain Methods are to be preferred."
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Prof. H. A. Nicholson, "The Nature of Life."

Tuesday, April 6th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. C. Pfoundes, "Art in Japan."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Huxley, "Dogs, and the Problems connected with them." (Lecture I.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "Explosive Agents applied to Industrial Purposes," and the monthly ballot for members.
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Photographic, 5A, Pall-mall East, S.W., 8 p.m. Mr. T. H. Dallmeyer, "A New Lens, or Objective, for the Magic Lantern."
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8¾ p.m. 1. Prof. Julius Von Haast, "Notes on *Ziphius (Epiodon) novæ zealandiæ*." 2. Dr. M. Watson, "Some points in the Anatomy of the Prosbocidea." 3. Prof. T. H. Huxley, "The distinctive characters of the species of the genus *Canis*."

Wednesday, April 7th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. Mr. E. C. Robins, "Buildings for Secondary Educational Purposes."
Entomological, 11, Chandos-street, W., 7 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Mr. J. C. Thresh, "Volumetric Determination of Alkaloids." 2. Mr. Thomas Greenish, "The History of Araroba, or Goa Powder." 3. Mr. J. B. Barnes, "Experiments on Taraxacum Roots." 4. Mr. A. W. Gerrard, "The Composition of Tonga, a Reputed Remedy for Neuralgia."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Thursday, April 8th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Applied Chemistry and Physics Section.) Mr. F. J. Friswell, "Recent Improvements in Benzine Colours."
Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. Frank Roland, "The Influence of Dramatic on Pictorial Art."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture I.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr Thos. Cole, "Teredo and other Insects destructive to Wood in Marine Works."

Friday, April 9th...Fröbel Society (at the House of the Society of Arts), 7½ p.m.
Royal Institution, Albemarle-street, W., 9 p.m. Prof. Huxley, "Coming of Age of the Origin of Species."
Astronomical, Burlington-house, W., 8 p.m.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
New Shakespeare, University College, W.C., 8 p.m. 1. Miss Eleanor Marx, "How Shakespeare became popular in Germany." 2. "Some Fifty Fresh Allusions to Shakespeare in 1592-1693."

Saturday, April 10th...Physical Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. James Sully, "Art and Vision." (Lecture I.)

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FRIDAY, APRIL 9, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The first Lecture of the third course of Cantor Lectures on "Art Decoration and Furniture" was delivered by R. W. Edis, F.S.A., on Monday, the 5th inst., and consisted of an introduction to the course in which the general principles of the subject were dealt with. The Lectures will be printed in the *Journal* during the autumn recess.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

In consequence of the general election, it has been considered advisable to fix the date for the Society's Annual Conference somewhat later than was originally intended, or than has been the case in former years. It will, therefore, be held in the beginning of June. The precise date will be hereafter announced.

As at the previous Conferences, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, will be in the chair.

A programme of subjects for discussion has been drawn up by the Executive Committee, and will be submitted to the Conference. The following are the subjects included in the programme:—

1. The development of Local Government administration, especially by the constitution of County Boards.

2. The extension of the powers of the local authorities of urban and rural sanitary districts. Amendments in the Public Health Act.

3. Sanitary inspection and classification of dwellings.

4. Amendments in the Rivers Pollution Prevention Act.

5. The advisability of strengthening the administrative organisation of the Local Government Board. Local Government Board Administration Areas.

6. Further suggestions by sanitary authorities.

The detailed programme will be issued shortly. Copies can be obtained, when ready, from the Secretary of the Society, by any person who applies. The programme will also be issued to sanitary authorities throughout the kingdom.

It is not proposed to make any attempt to procure papers which may be read and discussed; but the Committee will be glad to receive any communications containing fresh information, or giving accounts of progress made since the last Conference. Such communications, if approved by the Committee, will be printed and circulated at the Conference, but it is probable that time will not admit of any discussion being taken upon them.

INDIAN SECTION.

Friday, April 2, 1880; Andrew Cassels, Esq., Member of the Indian Council, in the chair.

The paper read was—

THE BEST ROUTE FOR A LINE OF RAILWAY TO INDIA.

By B. Haughton, C.E.

The first sod of that railway has been already cut which is the subject of this paper, and which I have ventured to call "a line of railway to India." The act has taken place at the Indian terminus, at Shikarpore, on the Indus, the point of its junction with the Indus Valley Railway. The line owes its inception to the war now being waged in Afghanistan, and to the pressing necessity for pushing our troops and their *impedimenta* into the enemy's country. It is called in India "the Candahar Railway," and it is said that, in January last, it had reached its 139th mile, near the south end of the Bolan Pass. The city of Candahar is 350 miles, and Herat is 650 miles, from the terminus. It is almost certain that Candahar will be reached before the close of the current year, and without doubt no time will be lost in the extension to Herat "the key of India."

The subject of a railway to India has been discussed over and over by some of the most active, thoughtful, and enlightened men of the age. I cannot, therefore, hope to do much more than bring forward an old subject, dressing it in somewhat of a new garb, at a period when it has certainly obtained new attractions and a new value, owing to political changes that have occurred; to the additional light that has been thrown on it as the years roll on; and owing to the circumstances that it is an essentially progressive subject.

In preparing this paper, I have to express my indebtedness to those great masters of the question

who have lived, and worked, and travelled, in the parts concerned, some of whom have written much upon it—viz., General Chesney, Sir Henry Rawlinson, Mr. William Patrick Andrew, Mr. T. R. Lynch, Sir Bartle Frere, Sir Rutherford Alcock, Lord Stratford de Redcliffe, Lord Sandhurst, Lord Strathnairn, General Sir Arnold Kemball, Rev. James Long, Von Hochstetter, the President of the Geographical Society of Vienna, Sir John Mac Neill, C.E., Mr. Ainsworth, Captain Jones, Captain Charlewood and others, several of whom have so thoroughly illuminated the subject by their evidence, given before the Select Committee of the House of Commons, in 1871-72, a committee which sat under the distinguished chairmanship of the present Chancellor of the Exchequer.

For myself, I may say that my interest in the question arose on that memorable 13th of October, 1869, when, thanks to the hospitality of his Highness the Khedive of Egypt, I stood on the forecastle of one of his despatch boats, the *Fayoum*, and watched the procession of the ships as they filed past into "the maritime canal of Suez," and on board of which many of the nations of Europe were represented by their emperors and princes, headed by the Empress of the French, in her yacht *L'Aigle*, followed by the Emperor of Austria, and the King of Prussia. England, conspicuous by the absence of any royal deputy, was unofficially visible in the person of the Admiral of the Mediterranean fleet, who steamed through the Canal gaily in his yacht, the *Deerhound*. Lord Houghton and Lord Alfred Paget, Sir John Hawkshaw, C.E., and Mr. Bateman, C.E., Mr. Gregory, M.P., Mr. Pender, M.P., Mr. Ramsay, M.P., were there. Liverpool was represented by Mr. Charles Clarke, president of the Chamber of Commerce; Manchester, by Mr. Grave, Mayor, and Sir John Bennett, chairman of the Cotton Supply Association. Glasgow, Edinburgh, Birmingham, Sheffield, and Bristol also were represented; Mr. W. H. Russell and many members of the Press were there; while four British ironclads added a certain picturesque effect to the scene, as they lay at anchor in the offing.

The witnessing of such a remarkable assemblage and brilliant pageant, having for its stage Egypt and the newly excavated maritime Canal of Suez, was sufficient to leave an ineradicable impression on the mind as to the importance of the occasion, and the magnitude of the issues bound up in the existence of this famous waterway; and that importance has not been diminished after ten years' experience of its working, and the near one million of pounds sterling of gross revenue that it now returns per annum to its proprietors.

The common conversation, then, amongst our countrymen, was this:—"The next event will be the construction of a railway to India by England, how soon, and what is to be the route?" These questions are, on the whole, still unanswered.

Several rival schemes are in the field—unless it may be that the commencement of the construction of the Candahar Railway has decided the line of country that is to be taken up. It sometimes happens in affairs, that when men hesitate in taking a side, and delay in the carrying out of an enterprise, the force of circumstances steps in and proclaims their inefficiency by deciding for them, and in spite of them. Of these several schemes I shall not now attempt to consider more than two, viz. first, that of General Chesney and Mr. William Patrick Andrew, *viâ* the Euphrates Valley and the Mekran coast to Kurrachee, which may be called "the South Persian route"; and, second, that which I more particularly advocate, or "the North Persian route."

The western terminus of the latter line will be at Constantinople, and its eastern terminus at Shikarpore, on the River Indus, about 250 miles in a straight line N.N.E. from the port of Kurrachee. It is impossible, at this stage of the matter, to settle the route from Constantinople through Asia Minor; several directions are suggested for it. Those most in favour seem to be two: that *viâ* Ismid, Angora, Sivaz, and Arabkir; and a more westerly route *viâ* Ismid, Karahissar, Konieh, Karabunar, and the Cilician gates. The centre of Asia Minor consists of high table land, throwing out ridges and spurs on all sides; it is a rough and difficult country, and is divided from the valleys of the rivers Euphrates and Tigris by the Taurus range of mountains, about which little appears to be known. Mr. Lynch has, however, stated in evidence that Mr. Consul Taylor has discovered a perfectly practicable pass for a railway at Arabkir.

In addition to the terminus at Constantinople, the railway will have a second western terminus, the site of which will be on the coast of Syria, from which point a branch line will be carried to join that from Constantinople, or, in other words, the railway will bifurcate at a point to be named on the southern slopes of the Taurus range, one fork leading from Constantinople, the other from the Levant. The absolute necessity of this last-mentioned fork is universally conceded, in order that England may always possess a free and undominated approach to the railway from the open sea; and, indeed, one cannot help coming to the conclusion that the Government, in gaining the island of Cyprus, had for the principal object of its acquisition to protect the Levant terminus, which will be just 130 miles from the harbour of Famagosta in the island.

The port of Swadia, on the Levant, seems to possess advantages as a point of departure superior to those of any one of the other ports recommended. The second fork, then, will commence at Swadia, will pass through the towns of Antioch, of 10,000 inhabitants, and Aleppo, of 70,000; it will cross the Euphrates, between Biredjek and Port William, the latter being the point where Chesney built up his squadron and launched it, having dragged it and all the rest of his *materiel* overland from Swadia; here the river is about 250 yards wide and 15 feet deep; the railway will then run along the slopes of the Taurus, not far south of the towns Orfah, Diarbekir, Nisibin, and Mardin, and will intersect the various roads leading south from Asia Minor into Mesepotamia, a most valuable factor in the position. It will then tap that great centre of the traffic of a large tract of country, and of population, the city of Mosul, resting on the right bank of the river Tigris, adjacent to the ruins of the ancient city of Nimroud, the scene of Sir H. A. Layard's discoveries; it will cross the Tigris south of the junction of the Greater Zab with that river, pass on by or near to the town of Erbil, cross the Lesser Zab, pass near the towns of Kirkuk and Kefri, where it is 90 miles from Baghdad, "the City of the

Caliphs," and which, by virtue of its large population, extensive trade, and commanding riparian situation, will be worthy of a branch line of that length. At Kefri, it finds itself close to the Persian frontier, and face to face with the "Gates of Zagros," a range known to Sir Henry Rawlinson, which it will cross at a point to be determined. The first town of note met with in Persia, is Kirmanshah; it then passes through Hamadan, which those persons who have read Lord Beaconsfield's "Tale of Alroy," will recollect, and shortly after reaches Teheran, the capital, due south of the axial line of the Caspian Sea, and from the point of view of traffic, the culminating position of the railway in Persia; here it is 70 miles from the Caspian Sea coast, and 550 miles from Tiflis, the Russian military depot of the Caucasus. At Teheran, the railway will draw into its embrace the whole of the Persian east, west, and central traffic—Ispahan being just 300 miles due south—the traffic from the north-west district cities, viz., Choi, Tabriz, and Reschdt, a point on the Caspian being included. The railway thence passes eastward through Scharud, where it is 50 miles from Asterabad, and 70 miles from the nearest point of the River Attrek, goes on by Nischipur 4,000 ft. above the sea level, Mesched 3,000 ft. across the frontier of Afghanistan, and into Herat 2,650 ft., of which town Colonel Malleson lately gave to the Society of Arts a most vivid and graphic description, and which is 100 miles from the Persian frontier already crossed. At Herat it will no doubt meet "the Candahar railway" before alluded to, and now being constructed. It will pass by the towns Sebzar, Farrah, and Girischk, through Candahar, on to the frontier of the territory of the Khan of Kelat, not through the Bolan Pass, but by a more practicable one to the north-west, and somewhat parallel with it, lately discovered, and which possesses advantages political and constructive superior to those of its venerable rival route; it leaves Quetta 10 miles on its right, passes through the Pischin, towards Gwal, to Durgai, at the foot of the Chapar mountain, the village of Khost, the Hurnai valley, the Nari Pass, Sibi, Mithri, to Jacobabad, and Shikarpore, its termination. Here it will be placed in communication with the whole of the Hindostan railway system, through Lahore northwards, and *viâ* Bombay to the south, as soon as the gap between Kurrachee and Ahmedabad shall be completed.

Between, and including Swadia and Shikarpore, the railway will thus accommodate about 24 cities and towns of considerable importance, while it is practically safe from the most combative of the Arab tribes, their country lying at the west of the Euphrates; not that these nomads are anywhere to be greatly feared; they cannot be more difficult to manage than the Indians of the American continent, who were similarly somewhat dreaded at first by the promoters of the Pacific Railway of the United States, but who are now easily and effectually held in check.

The route for a railway to India, has now been traced from west to east, or from its termini on the Dardanelles and the Levant, to its junction with the Indian railway system on the Indus; and it is one which will bring with it all those advantages and facilities in which the iron road is so productive, to five great territories, viz., Asia Minor, Mesopotamia, Persia, Afghanistan, and Beloochistan, penetrating them in their most vital parts, and most active centres of national industry; in addition to which, England and the most important dependency of Great Britain—India—are connected by a magnificent artery of communication. But this is not all; the benefits of this railway will not be strained, and exclusively scattered, for the advantage of the countries named. Europe *en bloc* will feel its invigorating and refreshing influences, and to the races of Asia shall be brought that contact with civilisation which is their birthright, when for the first time in the history of the world two continents shall become united by clasps of steel; let us endeavour that they may be forged and welded by England. It is certain, it is inevitable, that this, or some similar line of railway, will shortly be added to the category of accomplished facts.

We may, to some extent, arrive at an idea as to what may be the results of its opening, from the results which have followed the opening of the Suez Canal. The course of trade has rapidly accommodated itself to the new waterway; France and Italy have now got each its line of steamers to India, making frequent voyages; Russia has got its lines of vessels trading from Odessa as far as China, which have almost wholly appropriated the tea trade between those countries, while, as for England, the number of her new ship companies going eastwards is legion, and all this has occurred in much less than the ten years that have elapsed since the occasion of the marriage at Port Said of the Mediterranean and the Red Seas, while the Canal brings in a revenue sufficient to pay a handsome dividend on the capital invested. With such facts before us, we may most reasonably expect a profitable traffic from the railway, which will bring London and Bombay within seven days of each other, the cost of travelling by which, assuming the whole distance to be 4,800 miles, and rating the charge for passengers, first-class, at 3d. per mile, to include the expense of food *en route*, will be £60; second class, at 2d. per mile, £40—single fares. Much as we have learned to value railways, and fatigued as we are with the contemplation of the benefits they have conferred upon us, they still have surprises in reserve to delight and astonish us, and it is to the East that we must look for them.

The cost of the construction of a railway through these parts, as a single line of the first-class, with full station accommodation, and passing sidings, is generally computed to reach £10,000 per mile, the land being given *gratis* right through, equal to, from Constantinople to Shikarpore, a distance of 3,800 miles, a total of £28,000,000. The gross take from this capital expenditure, in order to pay 5 per cent., should be £2,800,000 per annum, or about £19 per mile per week. The present take of the Indian railways, double and single, is £27 per mile per week, and in the Island of Ceylon it is said to attain the large figures of £54 per mile per week. Whether or not £10,000 per mile will be sufficient to complete the railway, and equip it ready for working, cannot be said with certainty in the present condition of the question. Those persons who are acquainted with the character of the *terrain*, and who are familiar with the cost of

the Indian and Russian single line railways, consider that the sum should be sufficient. As high speeds will be required, and heavy loads will have to be carried, the gauge should be that of the English and Continental and Turkish standards—of four feet eight and a half inches. Unfortunately, the Indian gauge is five feet six inches, so that a transfer of cargo will have to be made somewhere *en route*. If the gauge were to be that of the Indian railways, such transfer should take place at Scutari, on the left bank of the stream of the Dardanelles; but by adopting the ordinary English standard, the transfer would take place in Indian territory, which would be preferable. The Russian gauge is different from both of those named, so that a break will also be necessary at junctions with the lines of that country.

Assuming the through distance from London to Shikarpore to be 4,800 miles, the time occupied on the journey, travelling night and day and continuously, would be, at 29 miles the hour, equal to seven days, which is as high a speed as it will be possible to travel the through distance for many years; and with the aid of modern appliances, such as Pullman cars, tatties, unexceptionable *cuisine*, &c., there is no reason why the journey should not be performed at all periods of the year, except, perhaps, two or three of the summer months, quite as comfortably as in going from New York to San Francisco, which is about a six days' ride. Mr. Allport, of the Midland Railway Company, has stated, in public, that he and his daughter having made the American trans-continential excursion, were not in the least fatigued, and had said to each other, on having arrived at San Francisco, that they could have at once started, without discomfort, upon the return journey, if they had felt it to be necessary to do so.

The principal rival scheme to "the North Persian route," is that *via* the Euphrates Valley and the Mekran coast, which was so ably and so eloquently described in a paper read by Mr. W. P. Andrew, from this place, in February last. He would gladly accept the boon of "a railway to India" by instalments, and so directed his attention on that occasion only to that portion of the route lying between the Levant and the head of the Persian Gulf. Whatever may be the route finally adopted, Persia is the key of the position. Persia consists of but a ring of available country, its central points being a waste. It resembles a finger-ring, moreover, in so far as this, that its jewels are embedded in one segment only, that facing the North-West and North, and those jewels are the cities and towns of Choi, Tabreez, Reschdt, on the southern shore of the Caspian Sea, Hamadan, rather inland, Teheran, the capital, Scharud, and Mesched. There cannot, therefore, be a second opinion, from the point of view of traffic only, as to whether the northern or the southern portion of this ring is to be occupied by "a railway to India," the inequality of distance between the two routes being inconsiderable. To judge from the minutes of evidence of the committee, the Mekran coast of Southern Persia is almost a *terra incognita*. One may observe scintillating through the fog that envelopes it, one town at 110 miles from the sea, that named Shiraz, worthy of the name, while Bushire, Bender-Abbas, Djask, Girischk, &c., seem to be insignificant places, and mere landmarks dotting the coast, to guide the weary traveller as he rides over 1,400 miles of country—which is the distance from Mohammerah, at the head of the Persian Gulf, to Kurrachee, in Scinde. Again, a railway in these parts would be of that most objectionable class of line, "a coast railway." Fed only from one side, it taps only half the country, and one-half of that population, which is the legitimate allowance of a railway well laid out and well placed at first.

It is by this South Persian route, commonly known as the Mekran Coast, that the Euphrates Valley Railway of Mr. W. P. Andrew can alone be extended to India, that is to say, it will pass through 1,400 miles of a district perfectly destitute of traffic, and with only one town of importance in that distance, which is Shiraz. Is it likely, except under circumstances of the most urgent necessity, that the railway to India will ever take up such a hopelessly barren and uninviting country? This is really the weak place in the scheme, and, to all present appearances, that which will be fatal to its adoption.

The Euphrates Valley route commences at Iskanderoon, in the Bay of Issus. It crosses the Beilan range of mountains, 2,100 feet high, at a short distance from the seaboard, passes through Aleppo, along the right bank of the Euphrates, visits the sacred places, Kerbela and Nedjef, and has its terminus at the fine harbour of Grane or Kowait, at the head of the Persian Gulph. Its merits are, the entire absence of engineering difficulties—bar the Beilan range—and the fact that Grane is an unexceptionable harbour, protected, healthy, having good anchorage, good drinking water, and being easily accessible. But, it has its disadvantages; it taps only one great town and centre of trade, Aleppo; the places, Kerbela and Nedjef, however, are not to be despised. Well, that gives just three towns of importance along a route of 900 miles. Again, it is only "a fragment of a railway to India," as described by Sir H. Rawlinson, and when the through route to India is to be made, only a fragment of this fragment will be available. A great point made in its favour by its advocates, is this, that a Euphrates Valley railway would be an alternative route to the maritime canal of Suez, and useful accordingly in the event of a stoppage of the latter by an enemy; that, however, ought not to be; and if it shall ever be attempted by Russia, she must first march across the alternative route, and if able to stop the canal, she can, *à fortiori*, stop the alternative. The breaking of bulk at each extremity of this railway of 900 miles in length, would moreover be an insurmountable obstacle in the way of its carrying a goods traffic upon the carriage of which there would be a saving of time of three days at the most.

When considering the question of a railway to India, its supporters and its pioneers, it would be ungenerous to overlook the part that the indomitable Chesney performed in introducing it. Just 50 years ago he made his first notes as he travelled in the districts concerned, submitted them to the King, received a grant from the House of Commons of £20,000 for the purpose of making surveys, which grant was supplemented by £5,000 from the Indian Government, took his orders from the Duke of Wellington and Lord Ellenborough, and having had two small steamers

built by Laird, of Birkenhead, and being full of enthusiasm for the enterprise, and buoyed up by the patronage of the King, he sailed from Liverpool on the 10th of February, 1835, in the ship *George Canning*, carrying on board his little iron squadron, stowed in pieces, as well as the *personnel* of the expedition, destined for the navigation and *reconnaissance* and survey of the Euphrates. He is gone, but, I hope, not to be forgotten whenever the truly great enterprise of an improved and a railway communication with India is being discussed. Contemporaneous events are worthy of note, as we pass on with the subject. The Liverpool and Manchester Railway was opened in 1830; the charter of the East India Company was abrogated in 1833; and Richard Waghorn established "the overland route to India" in 1834. It was Waghorn's route that caused the collapse of Chesney's *via* the Euphrates Valley. I take the opportunity to pay a humble tribute of respect to the memory of a gallant, generous, and brave spirit, and a born explorer.

The question as to that point on the Levant from which the railway should start, has caused some difference of opinion. Swadia possesses many and probably superior merits to any of the others. It was the port selected by Chesney for his landing; it is the port of the town of Antioch, eleven miles inland, with 10,000 inhabitants; it is irreproachable in the matter of health; it possesses an excellent anchorage and holding ground; it is the only port on the Syrian seaboard from the north down to Beirut that is not backed and separated from the interior by a mountain barrier. Chesney thus describes it:—

"The bay is seven miles wide, and encircled by a mountain girdle of striking grandeur, varied here and there by spots of most attractive scenery. Southward, a wall of rock rises from the valley below the wooded sides and bold peak of Mount Cassius, from which the outlying range of Gebel el Akrab runs eastward, at an elevation of 5,318 feet. Parallel to this bold range is the valley of the Orontes, with the hills of Antioch, showing near its termination; more northward, still forming the opposite horn of the Bay of Antioch, is Gebel Musa, a wooded and picturesque mountain, with the caverns and excavations of Sileucia in its lower slope, which terminates this magnificient panorama. The little town of Swadia, though scarce a mile from our ship, is completely hidden in the dense mulberry plantations which surround it. The scene before us was magnificent; for grandeur, beauty, and extent, it could scarcely be surpassed."

The River Orontes rises in the mountains of the Lebanon in about the latitude of Beirut, and flowing north and parallel with the Syrian coast for about 100 miles, it turns sharp to the west, and in a winding course forces its way through a defile in the Swadian amphitheatre, debouching into the sea at the centre of the bay. It is through this defile that it is proposed to carry the railway, upon a mean gradient of 1 in 234, and the gradients will be unexceptionable. The winding river will have to be crossed by bridges several times, and a sea wall must be run out to enclose a harbour, for which there is abundance of stone hard by. Nature has done much for this port, and art must perform her share in making it perfect. General Chesney says of this portion of the question, in his paper read before the British Association, 1857—

"Alexandretta does not promise to answer, on account of the mountains; ancient harbour of Seleucia also condemned, not sufficient depth; but on the south side of the bay of Antioch, a spot selected by Sir John MacNeil, admirably adapted for a safe and commodious harbour of refuge, can receive second-rate line-of-battle ships, and will be as good as the harbour of Kingstown. The spot is three miles south of the river Orontes, and six miles east of the old harbour of Seleucia. Harbour to be made by running out a breakwater on south side of a natural harbour; a perfectly safe and secure harbour for boats, with good holding ground. Stone of finest quality abounds close to where breakwater abuts on land; 1,000 feet of breakwater to be carried out at first instance, vessels of 18 feet drought of water may lie there during first 18 months. Harbour complete, shelter for 30 to 35 vessels; 20 to 40 feet deep; two chain bridges over Orontes necessary."

The other ports on the Syrian coast are Ayas, Iskanderoon, El Ruad, Latakia, Tripoli, Beirut, Sidon, Tyre, El Arish, and Acre. Mercyne also, a port on the Cilician coast of Asia Minor, each of these has got its friends. Iskanderoon, on the south shore of the Gulf of Issus, which is said to possess a good anchorage, is strongly advocated, but it is unhealthy, and is cut off from the interior by the Beilan range of hills of 2,100 feet high, which should be crossed by the railway by a mean gradient of 1 in 21 for 8½ miles from base to summit, and a maximum of 1 in 13 for one mile; also on the other side a mean of 1 in 18 for 6 miles, and a maximum of 1 in 13 for 2 miles. At the time that this suggestion was made, the Mont Cenis Fell Railway was in fashion, with its gradients of 1 in 12½, and the generally complicated mechanicism of its locomotives, but further experience of that system has not tended to raise it in the estimation of engineers, except in exceptional cases. To carry a heavy passenger and goods traffic over a mountain, where it may be carried on very easy gradients, is hardly likely to be adopted, even with the temptation of a good and cheap harbour to start with. Tripoli has for its spokesman Captain Lovett Cameron. This port is 140 geographical miles in a right line from the city of Aleppo, against 70 miles from Swadia to the same city, which would add 70 miles more than is necessary to the length of the railway. The principal attraction of this port in his eyes is its roadstead, and the facilities that exist for making a fine harbour and a port of magnitude, which will of course cost money. He states that, after leaving the plains that fringe the sea, there are hills around Homs to be crossed, a long viaduct to be built, and a great cutting to be excavated, so that Tripoli presents a rather formidable catalogue of difficulties to be overcome.

The strategical aspect of this great undertaking stands forth prominently, and the route *via* the Mekran coast is pronounced to be the most secure from attack from the north. No doubt it is so at the first blush, and 1,400 miles of it, viz., from Mohammerah to Kurrachee, lying close to the coast, the line could be easily protected by our ships; the most that can be said, however, is that the railway is only somewhat more safe here than on the North Persian route, and not by any means absolutely protected; for instance, at Mohammerah the railway would be only 250 miles from Ispahan and 380 miles from Teheran, cities that could be easily occupied by Russia in the case of a great war with

England, in which India was to be the prize. If the railway be carried by North Persia, it becomes a frontier line from Teheran to Herat for 600 miles. As far as Persia is concerned, it would, in this position, be that class of strategic railway which all nations desire to construct as soon as they possess the means. Such a railway is that of the London, Brighton, and South Coast line of railway in England. Russia possesses a similar frontier line, *via* Wilna, Grodno, Warsaw, Rowno, Balta, to Odessa. Other European States are protected in the same way; the object is manifest; such railways afford the means for rapid movements and concentrations between the flanks of an army for either attack or defence. Looking at the north Persian route, from a Persian point of view, it is just the line that country requires for defence; when, in addition to this, it gives her a direct and approach to the railway system of India, *via* Herat, Candahar, and Shikarpore, as well as an east and west line connecting the great cities and towns of her own country, there can be hardly a doubt as to her looking to such a railway as an essential member of her network of the future. If it be possible to effect a fusion of the railway interests of England and Persia, so much the better for both. By means of such a combination, we may look forward with hope to the early construction of "a railway to India," without it, the prospect, it must be confessed, is dreary to contemplate. From the railway concession given to Baron Reuter, some few years ago, which was brought about through the intelligent intervention of the Grand Vizier, Mirza Hassein Khan, we may judge of the anxiety of the Persian Government to inaugurate a railway system. This concession, at which, in the words of Sir Henry Rawlinson, "Europe stood aghast," however, came to nothing. According to the same authority, first, the Grand Vizier miscalculated the serious character of the Russian opposition; secondly, England's indifference; and thirdly, the determined opposition of his own countrymen. Russia showed intense chagrin, because of the negociation with a rival, and because her trade would be hampered by British *employés* at the Custom-houses on the frontier. The merchants of Moscow and Astrakan compound with the Russian officials on favourable terms for duties, and they were alarmed at the prospect of a rigid examination of Customs dues at ports of entry; for these and other reasons they made a resolute stand against the concession. Baron Reuter found it impossible to place the loan, or form a company, and the contract was annulled in 1873.

There is one more consideration which ought not to be omitted, when speaking of our communications with India. Russia has had surveys made of various routes suggested to join her network with that of India, notably that of M. Lesseps; are we prepared to stand by and allow her to do that which it is our own duty and interest to accomplish. The Rev. James Long says, "A railway from Orenburg to India is popular in Russia, 2,270 miles long, Peshawur being the objective point; the Russian mind is full of it. Hochstetter prefers the Caucasian Russian Railway."

It was stated last week, in the *Standard* newspaper, that the engineers of Russian ways and communications, had lately placed before the Emperor, for his approval of one of them, two designs for connecting the Caucasus and Persia by railway, first, from Tiflis *via* Tabreez to Teheran; and second, from the port of Baku, on the Caspian Sea, *via* Reschdt to Teheran.

The distances taken from Kiepert's map of Vorder-Asien, by compasses, shows for the territorial distribution of the mileage of this "railway to India" as follows:—

Turkey	1,000	miles.
Persia	1,000	,,
Afghanistan	600	,,
India	150	,,
	2,750	,,
Levant fork	250	,,
	3,000	,,

Twelve months ago it used to be said that Afghanistan would be the chief obstructionist, but twelve months of a period of vast national tension and effort are sometimes productive of vast and unexpected changes, that confound the wisdom of the wise, and reverse the predictions of the prescient. Now, we have changed all that; we have, to all appearances, got the wedge of control and tranquility well into the fastnesses of these lawless mountaineers, and shall be able to make short work of their interference with a railway; and, indeed, from some quarters we learn that, having heard of the great success of our Indian railways, and the amenities they confer on Indians, they (the Afghans) will be only too happy to have their country tracked by railways, and, in short, they look upon the fact that we have already made 140 miles of the Candahar railway, and that we mean to extend it; as a more powerful reason, why they should cry "peccavi," than those of the visits which our projectiles have made them. We may, therefore, dismiss our fears as to Afghan difficulties in the matter of the 600 miles of "a railway to India" that fall to the lot of Afghanistan, and look forward with interest to the period not now far off, when the cry will be heard on the Indus Valley Railway at the Shikarpore station, "Train about to start for Quetta, Candahar, Farrah, and the North."

The kingdom of Persia will carry and care for 1,000 miles of our proposed line. Persia may be held to be the key of the enterprise. Here at once will be our greatest difficulty and our best successes, but our difficulty will not be with the people of the country. Our difficulties will be of a different sort, for it is here we shall first have to deal with Russia. From Persia herself, her Shah, her potentates, and her people, we have nothing but support and approval to anticipate. The country is ripe for the introduction of railways, and, without doubt, will welcome the proposal that they should aid us with all their strength in the construction of a moderately devised design to give their network of the future a start; which must not, however, be of that heroic type which Baron Reuter and Mirza Hassein Khan projected for their acceptance. As to the feelings of Russia in the matter of the Persian instalment of "a railway to India," that is an affair of diplomacy, and it ought to be possible to get it accomplished

without paining her susceptibilities. It is here that the strategical aspect of the design will require the greatest attention, and to this point of the route that the eye of the soldier will be most watchfully directed. No doubt, railways play an important part in warfare, but so they do in matters of commerce and trade, and do we not all look forward with expectation to the period when the only works they shall be called on to do, shall be the works of peace. Russia is notably commercial in her tastes and desires, if she is also propagandistic and military, and it is notably from her commercial classes that the call now comes for a railway from Orenburg, or Tiflis, as may be, to Central Asia. Let us strive accordingly that our future rivalries with Russia in that quarter shall be rather commercial than militant, and that the diplomats of both countries may endeavour to solve the difficulties that will arise where dominant interests clash, and that they may crown the edifice by a treaty in which the rights of both nations shall be respected. Possibly, a determination on the part of Persia to connect her great commercial towns and cities by a trunk railway, running from West and East, may yet decide for us the strategy of the case by its entire effacement.

Turkey, and her quota of 1,000 miles, remains to be considered. She has long ago proclaimed her intention not only not to oppose a "railway to India," but to facilitate its construction by all the means in her power. So far then as enlisting the approval of the various nationalities through which the route will pass, things may be said to be fairly on the square. There is left the important factor, of the approval of the enterprise by the national will at home. England shows signs of arousing, in the presence of the responsibilities that belong to and attach themselves to her. She demeans herself as if she had arrived at the conclusion that a policy of isolation does not pay for a country and a people who are to be found located in every degree of longitude on the face of the earth, land, or water. She has had a run of bad times, coincident with a period of restless languor, such as is not natural to her sturdy and practical mind. She had previously passed through a time of extraordinary, physical, and mental activity, in consequence of the invention of the railway. Other astonishing novelties followed in its wake, the gold discoveries, the telegraph, and the Suez Canal, which latter gave her shipowners and merchants as great a surprise and shock as they have probably ever experienced. New patterns of ships became essential, steam vessels alone were available in the canal, new mercantile principles, and practice had to be adopted, smaller stocks of goods than before its opening sufficed for the exploitation of the trade to the East, in consequence of the shorter voyages made. Thus, practically, a considerable addition was made to supplies in hand, and glutted markets were the result, with all the troubles that follow them. But the good ship, though struck by a succession of squalls, has righted and refitted, and prepares for travel through new channels and seas. England is omnipresent in the world, how can she possibly confine her sympathies to the shires and boroughs of these narrow islands? Has she not become aware of this truth, and is she not now bracing herself to face it? as face it she must, or retire from the arena in favour of those who are more worthy of the world's confidence, if such there be. I trust it shall not be so, and that it will be found that the profusion of wealth which she holds has not yet emasculated her sons, as some philosophers have predicted it will inevitably do.

Two hundred and forty millions of natives of India, a gifted and most interesting people in many ways, await our fiat for the opening up of this route. That country has produced great statesmen and legislators, valiant warriors as well as eminent engineers, and architects of the highest capacity and artistic feeling, for where can be found on earth a building to surpass that beautiful and classic pile of marble, the Taj-Mehal, and what country has produced a more able and successful ruler than Aurungzebe. I am convinced that there is now a necessity for this railway. I believe in its success. I am confident it will become a source of good fellowship, as it will be a new bond of union, between us and them, and it is obvious that it will bring untold guerdons and gifts to lay at the feet of those outsiders who are the denizens of the two most populous of the continents of the globe, that is to say, of Europe and of Asia.

DISCUSSION.

Sir Arthur Cotton K.C.S.I, said that it appeared to him that the fundamental question to be decided had not been raised in the paper, and, of course, he could not say what the writer's opinion upon it was; the question was this, was the railway to be mainly an Indian railway, or to be constructed with reference to local traffic and interests; in other words, was the communication between England and India of sufficient importance to warrant the construction of a railway, independent of all local interests. The Suez Canal had no reference whatever to the locality through which it passed; it was a communication between Europe and Eastern Asia, and the population on the line of the canal itself was not considered. The question was whether this line must not be considered also in the same way. If it were to be mainly a communication between England and India, an entirely different starting-point must be taken in the discussion, to what it would be if either primarily, or in a great degree, the local traffic was to be considered. This point ought to be considered first of all, and in his own mind he had not the smallest doubt of what the result would be. He was perfectly satisfied that it would be found that the communication with India was so immensely predominant, that nothing in connection with the local traffic should in the least affect the question. The leading points with reference to it then were, first, that it should be accomplished with the utmost possible expedition. The immense importance of quick communication with India, now that the grand point had been obtained of a cheap one by the Suez Canal, was the most pressing, and he had no hestitation in saying that it was the first engineering work which ought to be undertaken by this country. Of late he had seen many distinct indications that England was beginning to take an entirely different view of the Indian question to what it did two or three years ago. The great difficulty had been to make English people realise what it was to put life into an industrious, tractable, and intelligent population, such as the 26 millions of India, and, therefore, they had treated this question of railways as, wonderful to say, they did the Suez Canal. That was not only looked upon with indifference, but

even discouraged by England, but now 3,000,000 tons a year were passing through it. Who could estimate what Lesseps did for England when he united those two halves of the British Empire? No engineering work in his opinion ever did, or could possibly equal it in importance. If the speedy opening of rapid communication with India was the grand desideratum, the important point was to have the shortest and easiest line to begin with, and, therefore, he would make it straight across from the Mediterranean to Bassora; that could be made in a very short time. He had passed over the whole of the line himself, and he felt confident that there were not 800 miles in the world which could be laid so cheaply and quickly. Taking Artah as a starting point, it could be made a magnificent harbour with great ease, by running out a groyne from the southern side of a bay, than going up the valley of the Kishon up to the water-shed of the Jordan and the Kishon; the ground was quite easy, there was a rough 80 miles on to the water-shed of the Jordan and Euphrates, passing a little to the south of Damascus. From a little south-east of Damascus the line was an absolute level to Bassora; there was not a grain of sand, or a stone, but perfectly level ground, on which the sleepers and rails might be laid for 200 or 300 miles, without breaking the ground. In fact, it wanted nothing but water to turn it into one of the most populous countries in the world. But of the 800 miles, there would be only 80 where there would be any engineering work wanted, and without any difficulty whatever. This could be done for £8,000,000 in a year or two, and then we should have at once this grand point attained of speedy communication, for in ten days we could get to India. Whatever might be done with reference to such a line as that described in the paper, it did not in the least affect the question of a direct line, which could be speedily executed for communicating with India. We could not afford to wait ten or fifteen years for a complete line of railway. He was perfectly satisfied that the Indian traffic would overwhelm the railway, and, as for its being dependent on the local traffic, it was out of the question. He would certainly make branches to Jerusalem and to Bagdad, perhaps 100 miles altogether, but that was a minor matter. Nothing had more surprised him than the extraordinary misunderstanding on the subject of India. Taking the debates in the House of Commons, one would suppose it was a great question whether India was not speedily deteriorating, but in truth there never was a country in the world which had made such progress as India had done. He had known it now for 60 years, and the change which had passed over it in the last 20 years was beyond anything he could possibly have imagined. He remembered when a weir was proposed across the Cauvery to improve the irrigation of the district of Tanjore, to cost one lac of rupees, and the proposition was received with a shout of incredulity by the whole European community; but since then, 20 lacs had been expended on engineering works of communication, irrigation, and harbours. And instead of being a question whether it would be possible to find a lac of rupees to spend on a single engineering work, one work in India, at this moment, was paying one lac of rupees a day in returns; three and a half millions per annum being paid by the East Indian Railway at the present moment. When the Pamba Pass was opened between Ceylon and the main land, the amount of traffic which passed through it was £17,000, but it was now £270,000. The trade in the Orissa, when it began to be improved, was £30,000, and it was now one and a quarter millions. All these things show the changes passing over India at the present moment, and he was quite sure that its future would surpass anything one could imagine. Before a railway had been in operation three or four years, it would be perfectly overwhelmed by the work it would have to do. This did not affect the ultimate question of a complete railway from England to India of 5,000 miles, but what we ought to do with respect to this was to immediately construct such a line as he had referred to, and if the proposal of a complete line kept us employed for 15 years, and put off the immediate execution of that work, which was so much needed, it would, he feared, only be injurious.

Captain Cameron, C.B., said he objected to being misquoted, as Mr. Haughton had certainly done in his paper. He contended that a line from Tripoli was the only easy run into the interior. He was glad to hear that the Taj Mehal was built by the Hindoos, for he had always understood that it was built by Italian architects. He was glad to hear also that Swadia was a good harbour; he could only say that many years ago he was there as a midshipman, and was very nearly swamped; he hardly knew a worse place for a ship to lie in. On the opposite side of the bay there was an anchorage, but it was no place to make the head-quarters or terminus of a railway. Some years ago, he was up and down that coast a good deal, and since then, at his own expense, he had done something towards looking over this line without any assistance from Government, or any one else, because he thought it was necessary for England to have a rapid means of communication with the East. Tripoli was the ancient entrance to Syria; the Egyptians, the Hittites, and many others used the route. The heaviest gradients they would have to pass would be 1 in 80, and that was not at all alarming. If Swadia were adopted as the terminus, as recommended, in the first 21 miles the Orantes would have to be crossed 17 times; and from what he had seen of how that river ran, it would cost a very large amount of money, whereas, by adopting the Bielan Pass route, you only had to rise about 2,000 feet; or make a tunnel of seven miles. He maintained that the way, which all history and geography taught was the right way into the interior of Syria, was either to Tripoli or Ruad. The latter was much used in the old days by the Phœnicians when they could pull their galleys up on to the shore, and they were safe from attack, but now to make a harbour at Ruad would necessitate a breakwater of two miles. At Tripoli, for the last 300 years, there had never been a wreck, but ships constantly come up from Beyrout, landed their passengers, and went back again. It was the seizure of Tripoli which gave the command of the Mediterranean to the Mohammedans in early days, and enabled them to carry their religion as far as they did. They would never have gone to Spain, Morocco, and elsewhere, if they had not gained this commanding point on the sea-coast. From the days of Moses, Tripoli had been the route into the interior. All he wanted was that we should have a communication in India, and he did not think a coast railway was so disadvantageous as Mr. Haughton considered it. At the same time he was not in favour of Mr. Andrew's line. For the last six or seven years a steamer had gone up the Tigris, but last year a Turkish steamer went up, and could not get down again, being jammed up for want of water. He not only held to the route down the Persian Gulf, but hoped that a railway would be made to Candahar, and that the day was not far distant when we should give Persia a port on the Mediterranean, at Tripoli, by connecting it with Teheran, and also on to Candahar with the same system. There were no great difficulties in the way, and he hoped shortly to go again and examine the Persian portion of the route. He was certain that, sooner or later, a great system of railways between England and India would be carried out.

Mr. Thomas Rumball, M.Inst.C.E., said that he had lately returned from Constantinople, where the first section of the line had been commenced. The company with which he was connected had made arrangements with the Turkish Government for taking over the line which the Government had made, being a portion of her contribution to the

Indian line. They had expended £600,000 upon it, and it was very badly laid out, but having examined it, his report was sufficiently satisfactory to justify the company in taking it over, and they had paid £100,000 to the Government for that section. They were now going to extend it to Aida Bazar, and afterwards they proposed going on to Angora. At present they only intended to make the extension to Aida Bazar, from which they would get a good traffic. The traffic on the section already made was only from £15 to £18 per mile a week, but that was because it was badly managed, and his own opinion was that they could double the traffic within a year, in which case it would show a fair profit. He had been as far as Angora, where the country was now a gentleman's park, in some places there being nine feet in depth of good black soil, and it was exceedingly well furnished with timber. He did not think the change of Government would prevent their first effort to develop the resources of Asia Minor, where the first things wanted were railways and roads. His negociations in Constantinople had been considerably protracted owing to the opposition of the French Ambassador, but he believed those difficulties had now been overcome, and he trusted that further sections of this railway would soon be completed by the aid of English capital. On the wall he had placed a photographic panorama of Constantinople, which was a splendid city of nearly 850,000 inhabitants.

Mr. Hyde Clarke desired to express his satisfaction that, after having for many years directed the attention of members of the Society to this subject, on the present evening some confirmation had been given to what he had stated. He fully concurred with what Sir Arthur Cotton had said in regard to the general principles to be applied. If the English Government would only undertake what was termed the Euphrates Valley Railway, it would be well worth their while to bring to this country those great advantages which had been referred to, but, unfortunately, there had been such an indisposition on the part of administrations to carry out that national undertaking, that it was very long since he had had any confidence that they could rely either on the Home Government or the Indian Government for such a purpose, and he, therefore, looked more to the gradual development of railways in Europe, and their continuation through Constantinople to forcing on the Indian and Home Governments the necessity of doing what General Cotton had pointed out as their part of the work. He trusted that, before long, whatever the form of Government might be, the Euphrates Valley line would be taken up; but, in the meanwhile, he had urged, and must continue to urge, that our attention should likewise be given to that portion of the line which had been executed in Europe, which was going on through Europe, and (as Mr. Rumball had shown) was again in our hands in Asia Minor. He would briefly repeat what he had said on a former occasion: that we had now a line from London to the Danube, and we had likewise in Turkey in Europe a considerable portion of line, constructed, not by ourselves, but by those unfortunate Turks. But who were the parties pushing on the junction between these two portions? Chiefly the Austrian Government; and we were dependent more on them, and on the Servian Government, than on our own diplomatic agents for the completion of that link. He had, however, some reason to hope that the attention of her Majesty's Government was at length given to it, and we might hope for the completion of the line right through to Constantinople—not by the contribution of English money directly, for fortunately that was not necessary, and it never had been necessary that our Government should contribute one penny to the completion of that line, but by directing our diplomatic action to induce the various parties interested to carry through that connection with Constantinople. He had pointed out previously how the line had been begun in Asia Minor, and how, through the difficulties of the Turkish Government, no progress was made beyond Ismid. Mr. Rumball had, however, stated that the line was now in English hands, and we might look forward to its being put in good order, and being continued. He could fully confirm everything he said as to the resources of the Ismid line, and if it were connected with Ada Bazar—which it could be at a small expense—it would be a paying line. If the English Government undertook the work, we had nothing to consider but the line from the Mediterranean to the Persian Gulf; but if we could not depend on the Government, and had still to wait, at least we should endeavour to promote in every way the continuation of the local lines, particularly this line through Asia Minor. As he had before pointed out, if you could bring to bear the European system in Asia Minor, it would introduce the machinery of civilisation. It was the continuation of that European impulse which would carry the line on, and develop the traffic at each stage in the way Mr. Rumball had explained, which would ultimately lead to that portion of the line being completed, to which General Cotton had referred; and either by the Government or by private means he felt confident that line would be made. If, however, we were to look forward to the completion of the line by extraneous aid, he feared it would not be by the course Mr. Haughton pointed out. It seemed to him that Mr. Haughton had neglected all the practical considerations which bore on the question, and relied on aid which would not be forthcoming. With regard to the Persian Government, the history of its negotiations and everything which had taken place since with regard to railway concessions, showed that we could not, in the least, rely on any co-operation from that Government. To propose, under such circumstances, to carry a line right under the Russian guns, through the north of Persia, abandoning all the practical points, did not seem to him to be an advancement of the question. Looking at the whole question, they must now see that they were in a more hopeful position than they had been for some time. He had hoped, when there seemed to be no hope, but it was certain that the interest in this line was increasing, and he trusted the Society of Arts had much enlightened public opinion upon it. He believed the period was coming of which General Cotton had spoken, and that at length the Government might be awakened to its duties in this matter. He did not wish to underrate the physical difficulties, but he was not aware that there were any substantial difficulties at any point. Captain Cameron had stated his case, as he always did, with very great ability and frankness; he should, however, presume to call his attention to the fact that it was not a case of Pharaoh and the Egyptians, who were going to communicate with Central Asia or India through Tripoli, but of England; and that there were the same historical grounds in support even of such a line as that brought forward by Mr. Haughton, as there were on behalf of his own line by way of Tripoli. With his historical knowledge, he must be aware that there was a great ancient route from Constantinople through the centre of Asia, and it was on that route Mr. Haughton proposed to work. He believed that the result of this discussion, and of that which took place a short time ago, would be to advance the object which they all desired.

The Rev. Dr. Badger said he had taken great interest in the subject of this railway communication for many years. It was upwards of 35 years ago that Mr. Andrew first brought out his Euphrates Valley scheme, and it was thought so promising then, that only a very few shares in the railway were to be apportioned to India. That reminded him of the old placards which the East India Company used to stick up when they wanted volunteers for the cavalry, saying that the troopers were not to hunt their horses more than three times a week. Some of the remarks of Mr. Hyde Clarke were

very much to the point with respect to the railway communication with India, which was to go through Turkey; for that part of the question, namely, what part Turkey was to have in it, had been entirely ignored. He thought one of the most sensible lines would be from Ismid to Sivas, thence to Diarbekir, thence to Al-Jazirah, and thence to Mosul, Erwill, and Kerkook, along the left bank of the Tigris, down to Bagdad. There might be some chance of such a railway paying ultimately, and there could be no doubt that it would do a great deal of good to Turkey. As regarded the Euphrates Valley line, whether you started from Iskandaroon or from Tripoli to Bassora, the greater portion of the country which it passed was perfectly waste. Mr. Andrew would take you from Aleppo to Beles, and then for 900 miles through a perfectly arid country, with scarcely a blade of grass in it. It was said that a line through Asia Minor would be open to the attack of the Russians; but by this route it might be destroyed by the Arabs. The Arabs did not want a railway; they had their camels, sheep, and horses; they did not engage in agriculture, but only migrated to the vicinity of towns at certain seasons for purposes of trade, and they did not want a railway to frighten their camels; and he thought it would be with very great difficulty the line would be preserved there. Mr. Andrew said it would save 700 miles in distance, and there was no doubt one of the great objects was to send soldiers quickly to India; but you had first to land them at some port on the Mediterranean, then to take them to Beles, and from thence down the right bank of the Euphrates to Bassora, in the Persian Gulf, where they must be put on board ship again, so that there were two shippings, which would cause delay; and as for the climate it was something terrible. People often said that there was nothing but a sheet of brown paper between the Red Sea and a certain unmentionable place; but that was certainly turned into a sheet of tissue in the Persian Gulf. He had resided near the Red Sea for twelve years, and during the whole of that time the Peninsular and Oriental Company's vessels ran from Aden to Suez. Being well known on the spot, he had every means of becoming acquainted with all the passengers. Many were going home to England, broken in health and constitution; but scarcely any died on the way. On the other hand, look at the reports which came from ships in the Persian Gulf. How many men-of-war had been there and could not remain for any length of time, the men being entirely broken down with the heat and the oppressive climate. He was there with Sir James Outram, and all he could say was, preserve him from going there again. The men were terribly oppressed by the heat, and worried by the mosquitos. Even the Arabs were obliged to tie themselves up in coarse bags, in order to protect themselves from these bloodthirsty creatures. He heard two Indian navy officers discussing this question, and one of them said they were so large, that he had seen one stand on his hind legs and drink out of a quart pot; and another affirmed, that four of them took him out of his cot, and put him on the floor: of course, he did not quite believe that. To take troops through such a place would be absurd. There was the Suez Canal, and if England could not protect that, let her withdraw all her ironclads, and defend the silver streak between herself and the continent.

Mr. Haughton, in reply, said he had endeavoured to explain that it was intended to develop the local interests of the line. Sir Arthur Cotton spoke of the Suez Canal being dependent only on through traffic, and it was quite true; but the Suez Canal was only 100 miles long, whereas the railway was 2,800. Captain Cameron had differed with him, as he expected, but it was a mistake to say that he (Mr. Haughton) had misquoted him, as he had cited from an article in *Macmillan's Magazine*, where Captain Cameron stated that there was to be a deep cutting, 50 feet at one end, running to nothing at the other, and also spoke of a very high viaduct which was to be made. The gradients which he had given were those taken from General Chesney's account of the gradients of the River Orontes, which was 1 in 264. Mr. Hyde Clarke had gone into the question very clearly, and had published an admirable paper on the subject himself. He objected to the railway being carried under the Russian guns, but all he could say was he could not see why it should not be made jointly acceptable both to Russia and England. There were a great many persons who, at the present day, advocated such a treaty being made as would enable England and Russia to agree, not only on such questions as that of this railway, but on other questions in Central Asia.

The Chairman said they would all agree that they had had a very interesting paper from Mr. Haughton. With regard to his closing remarks, as to a joint agreement between Russia and England in this matter, he feared they must wait until the lion and the lamb laid down together. It struck him very forcibly that if the line of railway projected by Mr. Haughton were carried out, it would be more for the benefit of Russia than of this country, and, more than that, its immense cost almost removed it from the region of practical schemes. He wished it were otherwise, and he also wished he could think as lightly of our difficulties in Afghanistan as Mr. Haughton did. He regretted to say he did not, and he feared it would be a very long time before those difficulties were sufficiently removed to admit of our establishing railway communication through the country. That it would be so some day or other, he believed, but that day was far off. Of course, like every one else, he should like to see a second string to our bow, and to have another means of communication with India besides the Suez Canal, but he agreed with Dr. Badger that our main interest was the Suez Canal, and that our first great duty was to maintain our fleet in thorough efficiency in every sense of the word. In these days, more than in any others, England was bound to trust in God and keep her powder dry. So long as Britannia ruled the waves, and we could retain a passage through the Suez Canal, we wanted nothing more, and that, at any rate, was quite within the region of practical politics. In conclusion, he proposed a vote of thanks to Mr. Haughton for his interesting paper.

The motion was carried unanimously.

FOREIGN AND COLONIAL SECTION.

Tuesday, April 7, 1880; R. Brudenell Carter, Esq., F.R.C.S., Member of the Council, in the chair.

The paper read was—

ART IN JAPAN.

By C. Pfoundes.

Art in Japan was, in the past, something very different from what it is generally supposed to have been, and it would be a great mistake to judge of it by the art productions with which we have been literally deluged in recent times.

It is a desire to explain what Japanese art has really been in its own home, that prompts me now to place before the Society of Arts, some notes of my experiences, gained during a residence of more than a dozen years in the country, and those comprised within the most eventful period of its modern national history. But few, of those who have written and spoken about Japan, have obtained any insight into the habits of the people, by residing amongst them, speaking their language, sharing their experiences, or adopting their customs; and I may say, indeed, that it was the conscious-

ness that there was much as yet hidden from my predecessors in this field of inquiry, which would prove valuable and interesting, that stimulated me in the study of the inner life and modes of thought of this most interesting people.

We are, as yet, only on the threshold of any clear knowledge of the art motives and education of the artist of Old Japan. The early visitors to the Far East, before and after the visits of the Polos, gave us but little, if any, information on the subject; nor did the Portuguese, Spaniards, or, later still, the Dutch, do much to enlighten us, although the latter held, for more than two centuries, the monopoly of social and commercial intercourse.

Kämpfer and Siebold deserve honourable mention, for the vast amount of material collected; but even Siebold was not permitted to see much of the people, living, as he did, in a provincial town, surrounded by officials and townsfolk well trained in preserving an impenetrable silence, when an inquisitive foreigner sought information.

Our first Minister Plenipotentiary, Sir Rutherford Alcock, most undoubtedly led the van, in giving us the means of acquiring a more intelligent knowledge of the beautiful art works of Japan, his collection at the Exhibition of 1862 being the first that had been seen in England. It is true that large quantities of lacquer, bronze, and ceramic art work had reached Europe and America, but most of it had been made for the foreign market.

Mr. John Leighton, F.S.A., when he read his paper before the Royal Institution, in May, 1863, made the next step towards awakening a more general interest in this subject.

In nearly all of the material since contributed to our knowledge, there is the defect to which I have already alluded, viz., an absence of personal intimate knowledge of the inner life and modes of thought so important for any adequate appreciation of the art of a people. There are constantly recurring misconceptions, elaborate theories founded on false premises, and innumerable errors of omission, as well as of commission, which sufficiently indicate the absence of authentic information as to matters of detail. Jarvis' book, interesting though it undoubtedly is, pointedly illustrates the truth of this remark. Besides various incidental faults of style, and loose arrangement, its value is seriously impaired by not a few inaccuracies, as well as misapprehensions, as to the meanings of the designs, &c.

Not only is it necessary that an observer, aspiring to describe adequately the arts of Japan, should have a thorough knowledge of the language of the educated classes, as well as an intimate personal acquaintance with their manners and customs; he needs also a familiarity with the popular literature, the poetry, and the classics of the people. The exclusiveness, the jealousy, and the restraint habitual in the presence of foreigners has to be overcome, and the inquirer has carefully to conceal the slightest sign of prying curiosity, or intention to utilise such knowledge as he may acquire.

Having myself first bridged over the wide chasm that of necessity intervenes between an intruding alien and the intelligent native—having lived amongst them, spoken their idiom, and, indeed, been accustomed to think, and even to dream in their poetic language—I may express what I have to say much as one of themselves. It has, indeed, long been my desire to strew broadcast the information I have gathered in this most interesting field, hoping that even such contributions as I may be able to make may prove an incentive to others to follow me in a pursuit that is so promising for students of Oriental lore.

A keen appreciation of the beautiful art objects which they contained, induced me to frequent the native bazaars. It was in those places—which were, for the most part, visited by the native gentlemen, and, therefore, not having any connection with the foreign trade—that I most delighted to spend my leisure hours.

When the feudal system in Japan collapsed, in 1868, thousands of families became suddenly impoverished. They were then obliged to dispose of their heirlooms and art treasures for bread, or, when not so hard pressed, being driven from their official residences, they could not carry back to their future homes, in the remote provinces, their bulky *impedimenta*. Immense quantities of lacquer, bronze, and ceramic wares were then thrown upon the market. So low did the value of such objects fall, that foreigners would not even pay the price for them that the gold with which they were decorated was worth. The native dealers were, consequently, driven to the last resource; the beautiful gold work was rubbed off with charcoal, and sold to the makers of the cheap meretricious ware of modern times to be used anew.

Desiring to rescue some of the beautiful bridal sets of the formerly great noble families, and hoping to save from destruction some of the choicest lacquer ware, I so far succeeded that I made a market for Japanese curiosities. I tried to raise the tone of the dealers, by assembling them together at the house of a man, one of the largest traders in art productions. I endeavoured to induce them to combine together to save the old art of Japan from utter destruction. In this effort I, fortunately, did not altogether fail. I saw then that ere long these beautiful objects would rapidly become most scarce in the land of their production, and their value enhanced. It was not, indeed, my fault that my success in this task was not much larger than it proved.

The history of art in Japan can only be very briefly spoken of. Indigenous to the place it most undoubtedly is. It is too distinct altogether from that of other Orientals to have been otherwise. On the original stock there may have been engrafted, from time to time, some foreign ideas; but long ages, and the profuse originality and independence of the native artistic mind, free of all trammels of any art canon, has produced a distinct stamp of nationality, in which foreign ideas do not seem to have hitherto maintained any permanent hold.

The potter's art can unquestionably be traced back to ages more remote than six centuries before the Christian era. It is recorded in Japanese annals that, in the century B.C., clay figures were substituted for human immolation on the occasion of the death of great personages.* Chinese

* Formerly "Jun shi" (to accompany the dead) was practised, singularly like Suttee and other heathen rites of pre-historic times. When the chieftain died, his wife and most faithful retainers prepared to follow him. Later on, about the beginning of our era, Haji no tsukune made figures of clay as a substitute for those

classical literature, and the Chinese written character came into general use at this period. In the second century, A.D., silk weaving was taught by natives brought from the adjoining continent, and pottery manufacture and other arts had made great progress.

About A.D. 436, Ishigara and other painters arrived in Japan from Corea; a century later, one Donchio made paper. About the same time, a pagoda was erected of bricks. Another century elapsed before tiles came into use. These were evidently designed after the old method of roofing, with sections of bamboo stems split in two, and arranged with the concave and convex surfaces placed upwards alternately. Shingles of split wood, and thatch were, and still are, in common use. About A.D. 668, fans were first made; then, as now, of 25 slips of wood, "Hi no ki" (*chamæcyparis obtusa* or *retinispora obtusa*). It is said that a bat's wing suggested the idea of paper fans of the ancient form.

In 701, a bureau was formed for the control of the artistic decoration of the Imperial residences, and eminent artists filled the official positions in it.

In 724, a Budhist priest, named Gioki, introduced the potter's wheel; he is also credited with having projected the erection of bridges, and also with the construction of the enormous figures of "*Dai Butz*" (or Great Budh), of bronze, which was then first constructed and used in Japan.

The first coinage, a small copper coin, was called "*Wa Do*" (Japanese copper); and this was, after a time, superseded by a gold, silver, and copper coinage.

It is noted that efforts to print books were made in 770; "*Dara-ni*," a Pali prayer, being the first issued. A native Indian introduced cotton about the same period.*

In the ninth century, a modification of the Chinese character came into use, and was tabulated by a Budhist priest.

About 1223, Kato and others came to China to glean information about pottery and other arts.

There are numerous records about this time of visits of foreigners, and of natives having travelled afar, to the advantage of arts and of civilisation in Old Japan.

In 1243, the Budh priests had extensively circulated books — chiefly religious, printed from slabs of cherry wood and stone—in the Chinese character.

In 1308, the Chinese style of art was fashionable in Japan for a time.

In or about 1443, the Ashikaga Shogun Yoshi masa introduced ceremonious assemblies, and the drinking of powdered tea; these meetings tended to the elevation of artistic thought amongst the higher classes.

In 1588, *cloisonné* enamel ware was manufactured in Owari. My impression is that the origin of this ware was an effort to imitate the ancient votive offerings of articles inlaid with uncut rough jewels. The most ancient *cloisonné* ware has not a smooth surface, and the old name, which may be translated, "The seven jewels," or "The seven precious things,"* is another link in the evidence in favour of my theory. Whether poverty or dishonesty, or both, prompted this, I cannot say.

Between 1573 and 1591, the Tosa style prevailed again. This Yamato, or Tosa style, was originally noted for clearness of outline, minuteness of detail, and delicate treatment. It gradually lost much of its vigour, but gained in beauty (that is, from a native point of view), the fineness of the strokes of the brush increasing. This gave place, for a time, to the Chinese styles of the "So" and "Gen," a sketchy outline, in a few hasty strokes, being its characteristic. "Uki-yo-ye" (popular pictures) were often in the Tosa style.

Foreigners were present in Japan from the first quarter of the 16th to the middle of the 17th century, but do not seem to have exercised much influence on the art of the people, however largely their orders for certain articles may have affected the productions for exportation. About 1627, the use of tobacco became general, and the metal workers of sword mountings had a new field opened to their industry in the fabrication of tobacco-pipes, and of tobacco-pouches.

It was not until 1682 that two swords seem to have been worn by the ruling class. Sword mountings formed a most important object for art work in Old Japan. Recently, large quantities have been broken up for the sake of the precious metal, the cheaper sort being converted into pipe mountings, and even into the metal-work ornaments for furniture. It has often occurred to me that some of these gems of artistic metal-work might have been made up into beautiful jewellery for ladies in England.

The "Katana" (sword) has always been con-

who would immolate themselves. Although the rite was prohibited, it was still, at times, practised in defiance of the law. In the days of Confucius (who was born B.C. 519), images were buried with the dead, and the "great master" predicted that eventually men would be again sacrificed, and men of ability become scarce. His prophecy was verified. When Haji initiated a check on this terrible custom, great improvement took place. Native annotators on the classics note this. About A.D. 3, "Suinin Ten-O" bestowed the "Haji Sei" on Nomi no Tsukune, who is credited with bringing about the abolition of the custom of burying the living with the dead. The derivation of the word is "Ha," the Chinese character for clay, "*ji*" or "*shi*," first of the two characters "shisho," teacher—teacher of clay images.

* In the year 813 Kobodaishi, the compiler of the present Japanese syllabary I, Ro, Ha, taught the tenets he had learned in his travels abroad. He was conversant with much of the Pali, Sanscrit, and Chinese literature, especially in Buddhist classics. The Devanagari alphabet of 47 characters bears a strong resemblance to the Bon ji—priests' letters—of the present, and it may be fairly inferred that the I, Ro, Ha was formed on this plan for convenience, at a period when Chinese was little known in this country except to the priesthood. "A Gongio" is the name of the book of prayers, from which the Chinese characters are said to have been taken arbitrarily; and from these he formed the Iroha, which has two forms. The five (5) vowels are combined with nine (9) consonants, giving a table of $10 \times 5 = 50$ syllables, or, rather, 45 syllables and 5 vowels. These historical notes will be extended in a paper to be read at the Royal Historical Society on the 15th inst.

* "Shippo" is the Japanese name for *cloisonné* or enamelled ware. The meaning of the word may somewhat explain the origin of the art. When the Budhist religion came from India, many of the altar decorations came with it, and these were often inlaid with precious stones.

The Seven Jewels are "*Sango*," pink coral; "*Kohaku*," amber; "*Shako*," mother-of-pearl; "*Ruri*," emerald; "*Meno*," agate; "*Shinju*," pearls; and "*Suisho*," crystal. "*Kin*," gold, and "*Gin*," silver, are both usually included in the term. Some natives say the name originated in the fact that the article must go through the furnace seven times.

Formerly, this ware was enamelled exclusively on a copper foundation, upon which a thin thread of metal had been soldered, forming the outline of the design. It is easy to distinguish between the old ware, which was rarely found in large pieces, and the modern ware, which is made from the size of a common bead up to that of mammoth vases, and other articles. Within the last few years, this work has been executed on porcelain, and of late some very beautiful and even large pieces have been produced.

sidered the badge of gentle condition in Japan, and has ever been associated in the mind of foreigners with the "yakunin" (official) or the "samurai" (daimio's armed retainer).

The rules of observances connected with the wearing of the long and short sword, or the single sword, were most minute, but have fallen into disuse.

The ordinary length of the "katana" blade was 2 ft. 0·89 in.; the small sword, or "wakizashi," worn with it, 1 ft. 0·8 in.

In full dress, the colour of the scabbard was black, with a slight tinge of green or red in it; the binding of the hilt, blue silk; the mountings of the guard and hilt, "shakudo" (alloy of copper, gold, and silver). The mountings were numerous, and the making of them is a special and honourable trade. Goto Yujo was a celebrated maker of the 15th century, whose descendants still exist. The work of this family is called "Iyebori" (the families' chasings).

A first group, called "articles of three places," comprises, first, the ferule on the head of the hilt, and the ring behind the guard; second, the two pieces of metal interwoven with the silk binding of the hilt, used to hide the hole of the rivet, and to ensure a better and firmer grasp of the sword hilt; and third, the small knife and skewer-like pieces of metal inserted into the scabbard, so as to be drawn out for use at pleasure. The small knife was used to throw at an enemy—the skewers to attach the heads of slain enemies to the girdle.

The guard ("tsubu") is often a wonderful piece of workmanship in metal. "Nanban" (southern iron) was considered the best, but they were often made of valuable metal, and worked up with gold and silver, into a detailed picture of battles, hunting, or scenery. Nearly every article connected with the sword was richly inlaid to correspond. Guards are also made of several thicknesses of leather, or raw hide, called "neritsuba," and also of "shakudo" (copper and silver alloy), and "shibuichi" (one-fourth silver, three-fourths copper). Silver and gold, separately and combined, as well as iron.

"Seppa" are the washers, of which there is one or more above and below the guard, made of flat pieces of metal, brass, silver, or gold.

"Habaki" is a ferule, extending about an inch below the guard, formed of the same metal as the "seppa."

"Kojiri" is the ornamental ferule on the lower end of the scabbard, often very beautifully inlaid to match the other mountings.

"Kurikata" is the small cleat on the scabbard through which the "sage wo," or silk cord, is rove. This is constituted of various materials, and generally made with the scabbard.

"Saguri" is a small hook on the scabbard, to prevent the sword slipping too far through the girdle.

"Tska ito" is the silk cord bound crosswise on the hilt. There are several styles of binding, "maki," "dashi me nuki," "katatemaki," "heomaki," &c. Some swords only have shark-skin hilts, without silk, but generally the silk binding is over the skin ("same,") those pieces which have the largest nodules being most valuable.

The sheath or scabbard ("scia") is made of a wood called "ho," generally varnished. Black and dark colours are preferred; gaudy crimson and variegated colours are affected by the old "swashbucklers." Leather covers are worn over the handsomely lacquered scabbards; shark-skin ground down, inlaid with shell-work or peculiar kinds of lacquer, is sometimes seen on scabbards.

"Sage wo" is the long silk cord, of various kinds and colours of sennet, about five feet in length for large swords, and half that for the short sword, used to bind up the sleeves preparatory to fighting.

On journeys, the gentleman's sword-bearer carried the honoured blade, covered with the "shiki hada," a sword-case of leather or cloth emblazoned with the owner's crest.

Between 1688 and 1702, Hishigawa Monobu, of Yeddo, made the Tosa style once more popular; he was succeeded by numerous celebrated artists. Modern artists do not seem to have been much esteemed.

Taiko, the great general of the 16th century, was himself a man of artistic tastes and some skill, and was renowned as a liberal patron of art.

The manufacture of artistic bronze is quite modern, dating from the end of the 17th century.

In 1695, printing in colours from wood blocks was so far perfected that five colours were used. Within the memory of citizens of Yedo, Chinese painters were the guests of the Shogun, and executed flowers and rural scenery. Now, Italian artists have been hired to teach modern art in Japan. Such is the result of indiscriminate change—a rush of a parcel of wilful schoolboys to overturn and demolish everything their astute forefathers had matured; and this in the most naturally artistic country under the sun.

When it is considered that the very first effect of the introduction of Japanese art-production in England was a wholesale effort to reproduce it, and copy it; when it is seen that this has had a most marvellous and widespread influence upon our own decoration, design, and colour, for household, dress, and architectural purposes; it must be admitted that there is something worthy of attention in the civilisation of a people whose art was competent to produce such an effect; and it is to be rejoiced at, rather than deplored, that the effort to copy and reproduce Japanese design has ever signally failed.

Let us rather continue to look to Japan for its beautiful ware, and let us, also, learn to duly appreciate its best work, and endeavour to induce its people to go back to their old art, rather than continue to sink, step by step, in producing a meretricious hybrid style of manufacture, that is neither Japanese nor English.

Art patronage in Japan was centred at the old court Kioto. The chief ruling clan, the Tokugawa, and the great nobles, vied in supporting art. The lesser nobles, the gentry, and the wealthy traders also contributed largely to its universal spread. An artist of repute was ever welcome and well received, and was never left with an empty purse.

The old nobility had amongst their retainers numerous clever artists, and, at their entertainments, these would exhibit their skill for the amusement of the patron and his guests. Whether residing at their own provincial fortified residences in state, or during the period of their enforced

residence in the city of Yedo, a numerous following of men of letters and artists always surrounded the great personages.

Much of the old art work was a "labour of love," and the leisure occupation of poor gentlemen; sometimes, of rich amateurs. Every detail was carefully executed; there was no eager haste to get rid of it, in exchange for the money of the hated foreign intruder. The object would be seen by art patrons and admired, whereas the article for foreign sale brought no reward beyond the pecuniary recompense; it went away amongst strangers, it was never seen by those who could appreciate its best points, and it is, therefore, not to be wondered at that it was inferior to the article made for the native art patron.

The beautiful work made for the Japanese themselves would be submitted to a circle of admiring fellow-countrymen. The art collector would have around him friends who, like himself, appreciated the best efforts of their own people. This praise from compatriots of high position, men of refined tastes, good culture, and great influence, affected the art worker in Japan as it would the artist of noble aspirations in any other country. Art objects were handed round the circle at such social re-unions, passed from hand to hand with due care and elaborate ceremony, duly and intelligently criticised, wiped with soft silk, and carefully returned to their silk-padded coverings, placed in packing-boxes, and restored to the care of the fire-proof store-house at once. Thus it is, that these treasures have found their way to us in such a perfect state of preservation. It only remains for us to fully understand now what was the intent of the designer and artist.

The objects most prized in Old Japan were not the articles so commonly seen amongst us here, so profusely displayed in the windows of tea-dealers and mercers—not even the lacquer ware we so prize as old, and have to pay such high prices for.

It was, first of all, old swords, sword mountings, tobacco-pipe and pouch mountings, pocket-book mountings, beads, the buttons called "Nedzakies"—those quaint and curious bits of carving, many of which are gems; fans, with autographs and seals, sketches by personages of note, ancient and modern, old scrolls, albums of beautiful sketches, Chinese or Japanese poetry, written in any one of the many curious styles, fantastical, large and small, from characters each several inches square, to entire poems within the area of a superficial inch.

Such were some of the art objects that were the delight of the cultured people of feudal times in Old Japan. Some gathered shells, pebbles, or geological specimens; some affected botany; nearly all loved floriculture; while a few defied the Buddhist prohibition against the destruction of life, and collected insects. A few practised some genteel pursuit, which they learned through the Dutch. Amateur photography was one of the most recent of these hobbies. Every gentleman in Japan had a hobby, while the maiden and the matron boasted of their skill in some especial lady-like accomplishment, musical, poetical, or more practical and domestic.

The artist and man of letters of Old Japan, like his impecunious brother in other countries, was usually a living evidence of the truth of the old Japanese adage, that "when the rich are stingy, the scholars are destitute." But the really clever artist was, as I have already said, welcome everywhere, especially when guests were to be entertained.

Specialists would exhibit their skill, prefacing their feats with elaborate preparation, but most frequently executing them with the simplest means; *Tours de force*, rapid splashes, darts, dashes, and sweeps of the brush, that were most puzzling, often until the final touch completed the design. A dragon was commenced by a vigorous splash, a dash; and a steady movement of the brush, with a regular backward movement, gave the exact idea of scales, and, when the ink was nearly expended, a few sweeps of the partially dry brush, and the clouds were depicted.

A single brushful of ink would be carried round and round in concentric rings, and a twirling sweep would then complete a sketch, like the grenade in a forage cap, which is the conventional emblem of the human soul, as it leaves the earthy tenement at death.

After the exhibition was concluded, the artist joined the circle, the cup passed round right merrily, ever replenished by the hands of youth and beauty gaily robed. Music and dancing were performed by professionals, and jest and poetry, were often the burden of the discourse; and sometimes the guests and dancers would play forfeits, a game like the Italian *moro* being most popular.

Skilled artisans were readily accorded personal interviews with the highest personages; and clever mechanics, foremen, and master tradesmen were most independent fellows in Old Japan.

The "Daiku San" (Master the great Mechanic), as the carpenter and house-builder is called,* especially considers himself entitled to "give himself airs," and carries his head high. He is architect and contractor, generally sub-letting the details of the contract to the various branches of the trade.

There does not appear to have been any officially recognised system of art education in Japan; the ancient bureau, that was subsequently (to A.D. 808) incorporated with the department of architecture and repairs of the palace, merely supplied sinecure positions for artists of eminence.

Artists served a kind of apprenticeship to distinguished teachers. Wealthy amateurs took lessons privately. Standard works of art were studied, while poetry and classical—as well as popular—literature were subjects with which it was necessary to have an intimate acquaintance. Many handbooks of art exist, some very ancient treatises have been reprinted, and several independent works teach by series of progressive lessons, founded on some ancient system of classification. The various branches of art are divided. First, there are progressive lessons, from straight lines to curves, then broken lines, the combinations of lines and curves, and so on, gradually, until trees, branches, and foliage are correctly drawn. Leaves are dissected and shewn in outline, and then filled in, both the upper and under sides, curved, and in various positions. Birds, also, are dissected; details of claw, beak, head, and plumage, all minutely

* Further information on these points will be found in the *Builder* for May, 1879, in articles on "Theatres," "Artisan of Japan and His Work," "Constructive Art in Japan," &c.

traced, first separately, and then combined; the various positions—in flight, and at rest, and foreshortening—are all illustrated. The so-called natural elements, water at rest, the torrent and the stormy wave, wind and rain, each in its varying mood, are all accurately depicted.

This very important point appears to have escaped the notice of my predecessors, who do not seem to have known of this progressive Art teaching, and I have already pointed out this matter to several writers on Japanese Art and other subjects.

Thus it is that the Japanese artist is taught to represent sunshine and haze, winter's snow and summer's flowers, the vagueness of dark night, moonlight and its shadows, fleecy clouds and thunderstorms. Further on, combinations are dealt with, when lessons as to seasonable plants, and as to insects, birds, and other objects of animated and inanimate nature are given. Rules and instructions as to the proper groupings for the various seasons, and also the conventional and arbitrary couplets and triplets so commonly seen in Japanese design in lacquer, ceramic, and bronze work, are also provided.

The following combinations are most frequently met with in Japanese design:—

"Phœnix and Paullownia imperialis." This design is to be seen embroidered on the imperial robes, and on them only, but is frequently depicted on fans, screens, and hanging scrolls ("kakemono").

"Pinetree and Stork." Both emblems of longevity, a common design, and most frequently used in the embroidery of robes presented to newborn babes, and on other articles, lacquer ware, &c., for festive occasions.

"Peony and Chinese Lion." The peony is a design usually sketched on large articles, such as screens at the entrance of temples ("tsui-tate") or on panels, ceilings, &c.

"Bamboo and Sparrow," both being of a mild and gentle nature, a design to be seen in embroidery, fans, screens, and household furniture.

"Equisetum (scouring rush) and Rabbit." It is supposed that there is an "usagi" (hare or rabbit) in the moon which scours it with the dried "Tokusa," a design found on a variety of articles.

"Willow and Marten (or Swallow)." The willow waves in the breeze, the swallow flits to and fro, a favourite design for fans.

"Stag and Maple." Maple leaves turn red in autumn and the stag in autumn calls the doe. There is a play in the idea of the colour ("iro") of the leaf changing, and the love ("iro") of the deer; generally sketched in screens, &c.

"Lespedeza and Sleeping Wild Boar." The wild boar generally makes its bed in clusters of "hagi."

"Cherry and Pheasant." The *prunus pseudocerasus*, cultivated solely for its bloom, is associated with the gorgeously plumed pheasant, generally used in embroidery and coloured designs.

"Plum and Nightingale." The plum tree, called "the poets' favourite tree," in allusion to the verse composed in honour of Naniwa no Oji (afterwards Nin toku Ten O) by Oni (or Wa ni). The nightingale is fond of song or verse; one of the most frequent designs.

"Moon and Cuckoo." In allusion to Yorimasa and his verse when he slew Nuye, the design is usually a bird flying across the crescent moon.

"Rushes and Geese." Geese flying long journeys carry rushes in their beaks, and, before resting on the water, drop the rush, and then alight upon it; an allusion to the care to be taken in choosing a resting-place.

"Chrysanthemum and Fox." Hanzoku Tai-shi, prince royal, was bewitched by the nine-tailed fox, in the form of a lovely damsel. He made her his mistress. One day she fell asleep in a bed of chrysanthemums, resuming the normal shape of a fox. He shot at it with a bow, and hit it in the forehead. Noticing his mistress afterwards to have a wound on her temple, this led to the discovery of her being a fox.

"Bamboo and Tiger." Tigers feared the elephants, and, therefore, hid in the bamboo jungle. This design is often seen on screens.

"Peach Trees and Oxen." There is an old Chinese saying, "Turn the horse loose on the flower-covered mountain, and the ox into the peach orchard."

"A Dragon Crossing the Summit of Fuji yama on the Clouds." Small snakes become dragons, and an abject mortal often becomes an exalted person, rising to a great height, and easily surmounting the greatest obstacles: an emblem of success in life.

"Long-armed Ape and the Moon." It sees the reflection of the moon in the water, and endeavours in vain to grasp it.

"The Mulberry and the Goat." Goats are fond of this plant, and its product paper.

No mistakes are permitted as to seasons and the appropriate objects. Conventionalised ideas appear in the accepted form in many common designs and groupings, but the artists of Old Japan are above being led by any canon that does not permit of an appeal to nature's hand-book of art, with the glory and charms of which they are ever surrounded. Theoretical to a fault, and systematic even in their love of variety, colour, and form, the Japanese artists, nevertheless, are no mere servile copyists of nature, like their neighbours the Chinese. They clothe nature with the full wealth of their ideal conceptions, and so confer upon it their own mental individuality.

Various schools of art have arisen, and for a time flourished, during the past ten or twelve centuries, of which even a mere enumeration cannot be attempted here. Foreign influence, supported by some leading patron of art, may for a time have kept up some peculiar or alien style. The popular desire was for broad and vigorous treatment, with the most marked disapproval of any re-touching, and other cloaks for the numerous sins of omission and commission of the artist tyro, which were held to be reprehensibly inartistic.

We must learn what not to look for, and what not to expect, in such an art as this. I may destroy more than one fool's paradise, when I say that observers will seek in vain for many attributes that we hold in the highest esteem. But, in doing this, I give more than I destroy, if I succeed in pointing out that there is much to be learned that is worthy attention, although as yet inclosed in a sealed book to even those few artists who have already devoted their attention to Japanese design.

As a fitting supplement to our higher and more æsthetic realisation of classic art, Japanese art, colour, and design may be made to teach a useful lesson. It is really wonderful that the art of this people is what it is, considering the many great obstacles they have had to contend with. Ever liable to sudden destruction by shocks of earthquake and the continued alarm of fire, that next most terrible and mischievous enemy to household art, the Japanese thought that if they were not burnt out of house and home more frequently than "once in seven years," as the old adage says, "they were fortunate, indeed." Subject to being roused up frequently in the middle of the night, and obliged to flee to a distance, alarmed by the fire-bell, and taking away hastily all the most valuable moveables; can it be wondered at that these people limited their art to the decoration of certain articles, of which the more valuable are portable, or, at any rate, moveable. If we remember that they are obliged to keep their household treasures carefully packed away in fire-proof store-rooms, never having in common use any but those employed for the simplest necessities, must we not be surprised with the singularly powerful æsthetic and artistic constitution which has, nevertheless, preserved and perfected an art that has of late completely overwhelmed us here.

It is not necessary to discuss further the broad question, and to deal with the technical defects or points of excellence in the Art of Japan, nor is it my desire to preach the universal copying of an alien art, but only to point out what is hidden to those who have not had the opportunities I have had to see that art untainted by the natives' recent rage for innovation and change.

I regret much to see the Japanese efforts to copy our art, and I rejoice at the failures in England to copy Japanese art. They fail, as we do, in this copying without understanding the art motive, or having a knowledge of the originals, or comprehending the fitness of things copied. I would not teach any royal road to mere reproduction, but I do think there is a wide field open for an enthusiastic admirer to point out the real value of Japanese art, to indicate the intention of the native artist, and to explain the poem or legend that has formed the inspiration of the sketch. A high authority has said that it would be a noble mission for anyone who would devote time and energy to the accomplishment of this task. When the hitherto hidden movements of art-thought of the Japanese is understood, their work will assuredly be better appreciated than it has yet been. Any object of Japanese ware, even the commonest, would most probably be found to be decorated with a sketch, however rough, that constitutes a scene in an idyll or a legend, or that illustrates some poetic or historic allusion.

As we are now ignorant of all this hidden meaning, we lose the pleasure that a cultivated native derives from the work. Our mere visual sense only is exercised, and we are often interested merely by the novelty, or blindly follow in the track of a passing fancy and fashion, without being truly pleased by the drawing.

When, however, we come to know that the woman wearily trudging through a snowstorm, with three children, is the mother of the infant she carries, and that that infant became the great Mongol conqueror, Gerghis Khan, we desire to know more of the story.

A bird flying across the crescent moon calls to mind the following legend of the brave Yori Masa.

About the year A.D. 1153, the Emperor Narihito fell sick, and the doctors could not discover the nature of his malady. Every night the Emperor was stricken with a horrible nightmare, and some of the night-watch noticed a dark cloud, which appeared to move towards the "Dairi" (Imperial residence). Presently, it rested, and above the cloud shone out two fiery orbs. A brave warrior and celebrated archer, Yorimasa, was chosen to destroy the evil thing. For three nights he kept watch, with a powerful bow and a few trusty three-feet shafts, feathered with the plumes of the pheasant, a keen blade in his girdle, and his follower armed with a trusty sword. They awaited the cloud, and, when it appeared, Yorimasa, with steady aim and his full power, bent his bow, and, as he delivered the arrow, breathed after it a soldier's prayer, "Namu Hachiman Dai-bo-satz" (I pray to the great Hachiman). One of the bright orbs was immediately extinguished, and with horrid noises, there fell down a huge animal, and Yorimasa rapidly drove his sword to the hilt into the beast nine times. The people of the palace discovered the dead thing to have a monkey-like head, the body and claws of a tiger, and a tail like that of a huge venomous serpent. The "Shiu-jo," wishing to reward Yorimasa, gave him a celebrated sword, called "Shishi no O" (the king of wild boars). Besides, knowing that he secretly loved Ayame* no Maye,† and that the love was returned, he bestowed her on Yorimasa. The "Kuge," who was appointed "Ben kan," or Imperial deputy, to present the sword to Yorimasa, aware of his reputation as a poet as well as of a brave man, bethought him of trying a verse. Just at that moment a cuckoo was heard, giving him the key-note—

Ho-to-to-gi-su
Na-o mo ku-mo i ni
U-gu-ru ka-na.

Immediately, Yorimasa answered him—

Yu-mi ha-ri tsu-ki no
A-ru ni ma-ka-se-te ;

making up a complete verse of 31 syllables. His scholarly readiness and wit increased his reputation as a soldier.

The literal rendering of this verse is—

The cuckoo
Above the clouds
How does it mount.
The waning moon
Sets not at will.

but, in reference to the royal favour won by the archer, it is also taken to imply—

Like the cuckoo
So high to soar,
How is it so?
Only my bow I bent,
That sent the shaft.

A combined triplet-emblem of Bamboo, Pine, and Flowering Plum Tree, is held to be especially suitable for festivals or auspicious occasions, such

* Ayame, the blossom of the *Calamus aromaticus*, or flowing sweet flag. Female names were usually derived from flowers.

† *Maye* is the ancient affix to female names. *Hime* was only used for the daughters of men of rank.

as marriage. A little bird perched on a blooming plum tree is an allusion to the poem:—

Haru same ni	With vernal showers,
Shippori nururu,	Wet and drooping,
Uguisu no	The nightingale
Ha kase in ni yo wo.	Fans (with its wings) the fragrant air,
Ume ga ka no,	Redolent with perfumed plum.
Hana ni tawa mure,	By the flowers' nectar entranced,
Shiwo rashi ya;	Of all else oblivious.
Kotori de saye mo,	Tho' but a tiny bird,
Hito suji ni	Were my future thus
Negura sadamuru,	Ever unchanged,
Ki wa hi totzu.	In single mindedness.
Watashia uguisu,	Oh, were I but the Nightingale,
Nushi wa ume.	And you (my love) the flowers.
* * * *	* * * *
Yagate	Ever like this
Oshiku bai,	The sweet dream of Oshiku.
Ja wai ja na.	Ah, indeed, 'twere bliss.

Innumerable instances of this kind might be adduced. It is in the popular literature of the people chiefly that such are to be found. A nation of great readers, with an extensive popular and classical literature, supplied with all the standard works by the numerous circulating libraries, at a charge that is not prohibitory to the poorest even, prince and peasant alike have access to the rich stores of folklore and Eastern tale, and even more solid mental nourishment. Old and young of both sexes eagerly peruse the pages of the popular writers, and the books are brought to the houses for exchange. The connection between the literature and art of the people is very close. It is, probably, the curiously complex nature of the ideographic Chinese character that establishes this connection. While the hand becomes accustomed to the use of the brush in forming the complete characters, the eye and mind are trained to the deeper meanings of them. Inversion of its phonetic and its ideographic values are not only common, but their attainment is studiously aimed at in poetical composition.

A literature written in a character that is founded on an elaborate hieroglyphic system, and only to a small extent phonetic, of necessity must have a very powerful influence on the art of the people.

Floral forms have a high importance, and widely affect the minor details of decorative art. The arrangement of flowers is also reduced to a system, taught in progressive lessons; the natural forms of the various plants are altered, but with an art that conceals the effort. Daily accustomed to these floral arrangements, backed with hanging scrolls of a Chinese poem or with an artist's sketch, in the hallowed nook that exists in every Japanese sitting-room, the mind grows accustomed to these objects. Every house has a little bit of garden; if without room for more, a box is found, containing a miniature garden in the area of a few superficial inches.

It is thus seen that there was, and is, as a deep current, a strong love of nature flowing through this people's art instinct. Periodical holidays furnish but an excuse to dress up and have a day's outing; even a visit to a shrine or a temple is ever attractive. Going to church is no mere dull prosaic routine of duty. The flowers of the season, from spring to autumn, furnish periodical excuse for these festive picnics. Pilgrimages to distant shrines give opportunities to visit beautiful or grand scenery, and celebrated places.

Delighting to look at scenery from a high point, the popular pictoral art may have been influenced by this peculiarity. Thus we see that their love of nature, of flowers, and poetry, was so intermingled with their domestic life and their art, their literature and poetry, that it is difficult to draw the line where art begins and ends.

Someone has said he preferred the songs of a people to their history, so I venture to give the literal rendering of a few from Japan. The following is the most ancient poem of Japan, attributed to a pre-historic semi-divine personage:—

Ya kumo tatzu	Countless piling clouds
Idzumo yayegaki	Idzumo envelopes.
Tsuma komi ni	Thus my spouse encase,
Ya ye gaki tskuru	A cordon round her raise
Sono yaye gaki wo	That my true love develops.

He rescued a maiden from being sacrificed to the demon of the mountains, and took her to wife.

The son of the Emperor, about A.D. 110, returning victorious from the North, composed the following:—

Ni i bari ya	Since o'er the paths
Tsukuba wo idete	Of Skuba-hill we went,
Iku ya ka ne tsu ru	How many nights in slumber have we spent?
Kaga na yete	Count them.

His retainer replied—

Yo ni wa ko ko no yo	Nights there were nine,
Hi ni wa to o ka wo.	Days there were ten.

There is a play on words in these poems, which however, it is utterly impossible to render without the Chinese character and elaborate explanation.

Wa ni, the Chinese scholar, who was the means of Chinese literature becoming popular in Japan, about A.D. 284, composed this:—

Nani wa dzu ni	In Naniwa (Osaka)
Saku ya kono hana	The flowering plum
Fu yu gomori	This winter has not budded:
Ima wa haru be to	But now that spring has come,
Saku ya kono hana.	The trees are blossom-studded.

The lady-love of the Emperor Inkio (412 to 453) wearily waited for his return from the wars. A spider, hanging from the ceiling, gave her a subject for this impromptu:—

Waga seko ni	To me my love
Kubeki yoi nari	This eve should come.
Sa saga ni no	Like tiny crab
Kumo no furu mai	This spider moves,
Kanete shirushi mo.	Yet to me presage gives.

Ota Dokwan accosted a rural maiden one winter's day, many centuries ago, in the vicinity of Yeddo, and asked for a rain-coat. She replied with the following thirty-one syllable verse. He was so smitten with her wit and rustic beauty, that her fortune was soon settled, and he became a patron of men of letters through her influence.

Nana ye ya ye	Seven or eight petal
Hana wa sake domo	Flowers bloom;
Yama buki no	The *keria japonica*
Mino no stotzu da ne	Has no berry or seed—
Naki yo kanashi	A sorry sight.

or

What I have not I cannot lend.
Though flowers bud and expand
In this lone mountain valley end,
A rain-coat there is not to hand,
For which I am deeply grieved.

The play, or inversion of sound and sense, in the original contains personal allusion, as well as play upon words.

This is a common spring verse—

Ume wa sai taka	The plums have blossomed
Sakura wa mada kaiena,	The cherries not yet;
Yanagi ya nai yo nai yo	The willows sway
Kase shidai,	As the wind directs.
Yama bukia uwake de	The *keria* inconstant
Iro bakari,	Love and colour affects.
Shion gai na.	Oh! but it can't be helped.

I will give, as a last specimen, an impromptu a Japanese nobleman composed, when I told him my desire to reach the heart and learn the art-thought of his people.

Yamato uta	Of *Yamato's muse
Oshite shiraruru	A knowledge acquire,
Adzusa Yumi	The bow strung for use
Hiku ya sawa naru	May be bent at desire,
Hito no kodoro mo	The heart of people is reached.

There is a poem of 31 syllables, in five lines of 5, 7, 5, 7, 7-syllable lines, that may be read in ten different ways by simply altering the arrangement of the lines, each arrangement giving a totally distinct poetical idea.

The folk-lore furnishes a fruitful source of artistic motive, but I necessarily leave what I desire to say concerning that for the pages of a volume that I have in preparation.

The proverbial lore is also a prolific field, as is characteristically shown in the following specimens:

Selection of Japanese Proverbs.

"If dogs go about, they must expect the stick."
"Before argument, proof."
"Before flowers, dumplings."
"Hated children fear not the world."
"Thankless labour gains fatigue."
"To speak loud, and purse the lips."
"Rubbish accumulated, a mountain arises."
"Lepers are envious of those with sores."
"Through the hollow of a rush to view the heavens."
"Good physic is bitter."
"Be careful to be careful."
"Offensively-smelling people are unconscious of it."
"Cheaply purchased, money thrown away."
"To give in and to win."
"Above the eye a wen."

Domestic felicity and contentment must have been important factors in the art-thought of the people; the æsthetic artistic constitution may never have been very highly stimulated, as it is often with our artists, yet the natives of all classes were ever within the circle of refining influences. The sons and daughters of the lowly were constantly holding intercourse with the cultivated, and it was common for those of wealth and position to have a numerous retinue of their social inferiors, who accepted the nominally semi-menial positions, for the sake of the culture to be gained by such intellectual home-life.

That home-life and domestic felicity varied very much from ours is not to be wondered at, but I must do the people of Japan the scanty justice to say that, with all the freedom and much talked-of laxity, there was a very high tone of social morality practised. The Japanese have never been unclean birds, defiling their own nests. There has always been a perfect system of discipline, an unfailing courtesy, and mutual considerations, and the somewhat public life, even indoors, precluded the exercise of that selfishness in the home circle but too sadly common in many other civilised lands.

Art patron and art worker were alike surrounded with the means of thoroughly enjoying life; youthfulness was not suppressed, and age was dignified, yet ever happy, on seeing the young happy also. At an early age in Japan the heir is appointed, and the senior retires from the active participation in the cares of life as soon as the successor is capable of conducting the business, or of filling the official position. The poor gentleman, and the humbler class of officials and pensioners of old, supplemented their income with the proceeds of some occupation, and it was such as these who produced much of the curious and beautiful art works now becoming most scarce in the land of their production.

Art at home in Japan penetrated beyond the mere heirlooms and treasures rarely seen; the living rooms, garden, and even out-offices exhibited an artistic good taste suitable to the position of the family. An appreciation of the fitness of all things was ever most markedly observable. The articles of daily use were not the beautiful lacquer and porcelain ware of festive occasions, for utility and economy were first considerations. Keeping up appearances was never very popular in Japan, save and except the rivalry between the softer sex in the matter of wardrobes.

The love of nature and rural surroundings prompted a garden, or, at least, a miniature of one, and pots of flowers of the season were plentiful and cheap, so that the poorest could, to some extent, satisfy their intense craving for beautiful natural objects. The architecture can only be passingly alluded to, but the illustrations of it exhibited on the walls will give a better idea than any elaborate word-picture could. The interior decoration was always most chaste; the family cognisance usually formed an integral part of the design of the pattern of the paper, the metal fittings, and other details. Partitions being sliding panels, six feet high, in pairs and fours, filling spaces of 6, 9, or 12 feet; the inner slides were papered, and often decorated by hand, while the outer slides were covered with a thin paper; glass has only very recently been used to any extent. The space between the slides and the ceiling was, between suites of rooms, filled with carved ornamental woodwork; the ceiling itself of Chryptomeria. Furniture proper there was none; the mats formed bed and lounge; it was made of thick straw padding, with a finely-woven mat of *Juncus effusus*, *Isolepsis* and *Cyperus rotundus*, neatly bordered. There was in each room an alcove, in which to hang a picture and place a vase of flowers, and a recess with shelves was sometimes added. All household and domestic conveniences, table ware, &c., were movable, and brought from the out offices as required. In summer a small box, with charcoal for the smokers, and in winter large brazers to heat the apartment, being used, there was little smoke, and no fireplace, and dust and coal. Chests of drawers were placed in recesses in the women's apartments, while in the smaller houses cupboards were concealed by neatly papered sliding doors.

The decoration of costumes of ladies of the palace, and the gala robes of the young girls of all classes, but more especially of dancers and singers, gave ample room for the display of the arts of the dyer, embroiderer, and painter. The material being purchased in the piece uncoloured, pattern books were furnished—the more artistic had special designs—colours being selected by the ladies of the establishment, after much discussion, very much like that which takes place here at home; this feminine delight had its chief reward when the wardrobes were periodically aired under

* Yamato, the poetical name for Japan, the province wherein the residence of the Imperial Court was situate, is so named.

the eyes of admiring, and often envious and critical, neighbours. Some of these robes are elaborate and beautiful works of artistic skill. The family crest is sometimes figured on either three or five places, the chieftain wearing it about the size of a florin, and the retainer much larger, on back, sleeves, and breasts. Nude art has had no place in Japan; robes were worn as an ornament, rather than as something to conceal the figure; an accidental display of charms carried no immoral consciousness with it, and there was a blissful ignorance of the utility of prudery. Indeed, apart from foreign influence, the purity of thought, of even the common people, is very remarkable. The fancy articles of personal wear or ornament were never numerous, costly rings and jewellery not being in use. The ladies delighted in amber-coloured tortoiseshell hair-pins and a comb; beads of pure pink coral and of amber were worn on silver or silver-gilt hair-pins; but it was the tobacco pipe, pouch mountings, and pocket-book clasps, where display was most common. The *Inro* (*chatelaine*) we know, as the little medicine-boxes in five pieces, were universally worn; but all these were hung from the girdle by the *nedzukies* (buttons), which, of late, have grown to such a large size, in response to the universal foreign demand for these curious carvings.

A mere enumeration of the art-productions of Japan would occupy a very large space; but of the old ware, not specially made for foreign markets, the bulk of the lacquer we have received consists of portions of the bridal outfits of the noble and wealthy maidens of Old Japan. Vases and other articles were rarely made in pairs; this is purely a foreign taste. Of the innumerable household articles of daily necessity, or of luxury in Japan, few things come to us, and of the articles most commonly met with here, few are to be seen amongst the natives who are fortunate in not having as yet acquired foreign tastes and doubtful habits.

Japanese ware, no doubt, found its way west long before the advent of Europeans there; coming through China, the Arabs, and India. Any account of the modern art-productions would be out of place here, in speaking of the art of Japan, as seen in the homes of the people. The evil influences I have already more than once alluded to, as exercising such very baneful effect on Japanese art, it appears to me have arisen in the advice of the low and illiterate class of natives, who have had the trade with foreigners in their hands. These men formerly peddled their wares amongst the foreign shipping and the residences of foreigners. They were, unfortunately, credited by their countrymen—who kept aloof from the detested foreigners—with having a knowledge of the predilections of their customers; the tastes of the man-of-war's-men, and of the merchant seamen, were confounded with the ideas picked up from the better class, which were most frequently misunderstood. The result is, as we see, a hybrid, meretricious class of work, that is by no means a credit to, or likely sustain the reputation of, his people, hitherto the most artistic nation in existence.

This wholesale production of cheap ware is destroying the old art, and has already proved fatal to much that was most beautiful in the indigenous art of Old Japan.

Concluding this somewhat lengthy communication, I proceed to describe the designs of some of the articles before the meeting, which I am enabled to exhibit through the kind liberality of Mr. Cornelius Pare, of Messrs. Londos and Co., London-wall, and also to draw attention to about three hundred sketches that I have selected from my own collection, as well as several scrap books filled with popular sketches and scraps, artistic and pictorial.

Of these designs, there are many that are most frequently met with, and regarding which some erroneous ideas are being perpetuated:—The plum, the first flower of spring, is mistaken for the hawthorne; the carp is erroneously described as a salmon; the long-nosed gnomes are not understood, they are simply a caricature of pedantry. But the greatest mistake is confounding China with Japan. We might as reasonably associate France and Germany, or Italy and Scandinavia together. Even those who have lived in Japan, frequently blunder in this way.

The interest of any work must be enhanced when we know the motive of the artist; but the fire of our enthusiasm of necessity expires where there is want of fuel. There has always been great difficulty in obtaining any authentic detailed information; residents abroad are most apathetic, and the native students who come here have not the information we seek. Those who visit the country get into the wrong groove, and fail, in consequence, to obtain the particulars we most want. A good book on these subjects is much needed; for the tyro has to wade through hundreds of volumes, and finally becomes bewildered before finding "the ha'porth of bread amongst so much sack."

Lord Derby is said to have once remarked, at Liverpool, that there were not six men in England competent to speak on art. What must such art be, when it goes so far over our heads that we cannot even see it in its flights? Rather, like the art of Japan, let our art become popular, let it appeal to our feelings, and make us better men. I say, let art descend, that it may reach the lowness of our nature, and rise once more, bearing us with it. Such is the lesson I would ask you to learn from the art of Old Japan.

DISCUSSION.

The **Chairman** said he should like to know whether it was really the case that the *cloissonné* ware was a lost art in Japan. The old *cloissonné* enamel, of which most people had seen specimens probably, and of which the greater part that left Japan was in the possession of Mr. Bowes, of Liverpool, was on metal of extreme thickness, and though *cloissonné* patterns were worked on both sides, the articles were still so thin as to be almost like paper; but it had been said that this old art had been entirely lost. In the Oriental shops they saw imitations of this old work, mostly drawn by French and Italian artists, but on a foundation so thick that, when the articles were finished, they were absolutely ponderous. It would be interesting to know to what causes the decay of this manufacture was due, and what prospect there was of a revival of an art which commended itself more than anything else Oriental he had seen, by reason of an exquisite harmony and sobriety of colour, which was by no means a characteristic in the comparatively garish examples of modern work which were now so often met with. He feared it was one of the disadvantages attendant on

special erudition, that it rendered those not possessed of similar knowledge indisposed to raise questions or initiate discussions in its presence. If no one had any remarks to make, he would beg leave to present to Mr. Pfoundes the hearty thanks of the meeting for the great pleasure he had afforded, and to ask him to utilise the time which was left in exhibiting the numerous drawings and other specimens which he had brought.

Mr. Wall said the custom had been alluded to of introducing a large number of small dishes before each guest; and, strange to say, a somewhat similar habit prevailed in Sweden. Those who had been in Gothenburg would know that, at some of the public gardens there, they brought you a tray with a large number of very small dishes. He should also like to ask if Mr. Pfoundes could trace any similarity between Burmese and Japanese work. He had shown a bell, and spoken of the large size of some of the bells in Japan; and Burmah was also noted for its bells. No doubt he had seen some of the curious boxes made in Burmah, on which the decoration was exceedingly minute. They were made of bamboo, polished down, and then covered with lacquer work very similar to that which came from Japan, and they were very durable. He had some in his possession which he brought from Burmah twelve years ago, and which were still uninjured, though they had been in use ever since; and yet they were so thin they would bend almost in any direction. Some time ago he attended an exhibition in Calcutta, where some very remarkable Japanese paper was shown, so strong that it was fitted for making boots. On taking their common tea paper and pulling it apart, it did not break off like English paper, but pulled out in long fibres; in fact they felted their paper so beautifully, that it was almost equal to leather. Another point which had struck him in Japanese work was, that the makers always put a decoration in the corner of a box or other articles. Their boxes, when first introduced in Calcutta, sold for enormous prices; he had paid £3 or £4 for things which could now be bought almost for as many shillings. He would also draw particular attention to the screens which were exhibited. Those much accustomed to ladies' work would see something about the mode of decoration which he was not artist enough to describe, but which was far beyond anything he had ever noticed in our mode of decorating such articles.

Mr. Pfoundes, after thanking the meeting for the kind reception he had met with, said he had been compelled to leave out a great deal he should have liked to say, for fear of making the paper too long. He must apologise, therefore, for its appearing somewhat disjointed, but sailors were not, as a rule, literary men; and his idea had simply been to bring before the English public the crude notes he had collected during his 13 years' stay. He had essayed to get away from the beaten track of the globe trotter, or foreign resident, immersed in the task of trying to scrape together wealth, and to get rid of that insular egotism which was the misfortune of almost all Englishmen abroad. He therefore, threw himself entirely among the natives; and in bridging over the wide gulf between himself and them, the first thing he had to do was to learn the language, and to learn it so that when he heard them talking together he could understand it. Then it became necessary to ascertain and adopt their customs, so that he could mix with the upper classes, and see them as they saw one another. *In vino veritas* was true in all countries; but the Japanese were not like some other civilised nations; they did not give way to their bad passions; at least, he did not see much of such things. He had spoken altogether of Japan in the past tense, and he feared that much which he had described had been already swept away; and it was with a desire to perpetuate what would before many years be a thing of the past, that he had made himself so prominent in this matter. He believed the alteration in the *cloissonné* work, to which the Chairman had alluded, was altogether due to foreign influence. Foreigners, when they saw the fine old specimens, would think they were too fragile to bear transport, and ask for something stronger, and so by degrees the dealers would come to furnish thicker and heavier articles, as having a more ready sale. He knew himself that great numbers of objects, which would be very valuable now, were lying for months and years in holes and corners in the bazaar; but the things which the Japanese themselves cared most for, were not those which went into the market. With regard to the large number of small dishes in Sweden, that was one of the things which showed that human nature was the same all the world over. There was yet a great deal for the comparative student to find out, and it was only recently that a society for the development of folk-lore had been founded. It occurred to him that the idea in the Japanese mind, in having so many plates around them, was to be hospitable; but they knew that a pint bottle would not hold a quart, and that a man could not eat heartily of a dozen dishes, though he might taste even two dozen. He thought they had taken this idea from the Chinese, for, when he was navigating master of a Chinese-owned ship of foreign build, he found that a great number of dishes was considered a proof of hospitality. He did not know so much of Burmah as of Bangkok, Siam, and Singapore, but Buddhism was common to all these countries, and that would account for many similarities. The Japanese, in old days, travelled to China and India, and brought back with them Indian designs. There were two great branches of the Buddhist religion, the Pali, and the northern branch; the latter, coming overland, through Thibet and the vast continent of Eastern Asia, would be naturally more or less modified from the pure Indian type. His own idea was that in ancient times there was a maritime commerce existing in those seas, of which we had now very little idea. He had a theory that all the traces we ought to have had handed down to us were destroyed at the time of the Spanish and Portuguese discoveries. There could be no doubt that those people had in their hands very important information with regard to previous discoveries, but there was so much rivalry between them in early days, that the Pope drew an arbitrary line west of the Azores, which was subsequently shifted 200 leagues further westward, and said that the Portuguese were to have all to the eastward, and the Spaniards all to the westward. From that, he believed, arose the terms, West and East Indies. Long before that he believed there was an extensive commerce in the eastern seas between the Japanese, Chinese, and Loo Choos. In the sixth century, the Arabs had such a hold in Canton, that they occupied much the same position we did after the Chinese war; and there was probably an extensive commerce in those eastern seas long before our era. In that way, Oriental and even African ideas would easily reach Japan. Many old things much prized in Japan were not Japanese at all; some were of Malay, and some even of African patterns. Only recently he had been conversing with an African traveller, and it was wonderful, on comparing notes, how many of these corresponded. The Japanese had always been anxious to get the ideas of foreigners, but to keep the foreigners themselves out of the country; to squeeze the foreigner like a lemon, and then throw him away. They wanted our brains, and next to get rid of us as soon as possible. They could not close the treaty ports, but there was good reason to believe that if they could they would turn foreigners out of the country; and he believed that Japan for the Japanese would be the cry of the future. There was a curious similarity between the Japanese bells and those in Thibet, and, if he recollected rightly, it had been stated that an enormous price was asked for one of those curious old bells in Thibet.

The meeting adjourned, after passing a vote of thanks to Mr. Pfoundes.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 7th, 1880; Prof. A. Williamson, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Acheson, William, 2, Montpelier-square, S.W.
Barcroft, Henry, The Glen, Newry.
Bertram, Henry John, 100, Dean-street, Soho, W., and 25, Brecknock-crescent, N.W.
Dale, David, West-lodge, Darlington.
Dent, Alfred, 29, Chesham-street, S.W.
Gilbert, Walter Knapman, 2, Queen-street-place, E.C.
Hand, Commander George W., United Service Club, Pall-mall, S.W.
Helliwell, Thomas William, Newlands, Brighouse, Yorkshire.
Kelly, Frederick, F.R.C.S., Hotel de l'Europe, Brussels.
Potts, Joseph, Jun., North-cliff, Roker, Monkwearmouth.
Quinlan, Thomas, Royal Army Clothing Department, Pimlico, S.W.
Schiff, Charles, 43, Lothbury, E.C.
Seligmann, Edward, 34, Clanricarde-gardens, W.
Winter, F., 138, London-wall, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Brittain, Henry, 200, George-street West, Birmingham.
Gardner-Bain, Andrew John, Blairnairn, Helensburgh, N.B.
Horner, Edward, May-place, Crayford.
Rolls, George, 34, Camberwell-green, S.E.
Scott, William Thomas, 57, Canonbury-park North, N.
Taylor, George W., 116, Cannon-street, E.C.

The paper read was—

BUILDINGS FOR SECONDARY EDUCATIONAL PURPOSES.

By E. C. Robins, F.S.A.

It has long been the meritorious privilege of this Society to inaugurate valuable reforms in social and political economy, and to materially aid in the development of educational, industrial, and commercial enterprise.

It is here that the enthusiast, charged with some fixed idea as to the particular mode by which improvements may be effected in any time-honoured custom, or antiquated system of doing or thinking, may deliver himself of his crotchet, and bring to the test of discussion the result of his lucubrations.

The earnestness and honesty with which opinions may be stated are sure of appreciation here, even though the convictions themselves do not find approval; and therefore it is that one feels free to speak one's mind in this room without let or hindrance, knowing well that the wheat will be separated from the chaff by the interchange of ideas, and that progress of a more or less substantial character will result from the consideration of the questions at issue.

Upon the subject before us to-night, an immense variety of opinion has existed, and still exists, and it is no purpose of mine to claim exceptional superiority to, or even exemption from, the weaknesses of others. Nor shall I stay to magnify their deficiencies, but rather try to add what I may towards the solution of a problem which is every day becoming more interesting as its importance is more keenly felt.

The inconsistency subsisting at the present time, with reference to the supervision and control of educational buildings, will be obvious to all whose attention has once been drawn to it.

While in elementary schools, workhouses, and lunatic asylums, restrictions are imposed, and rules and regulations are enforced, which prescribe the minimum superficial area and cubical space to be allotted to each inmate, in secondary and higher class school buildings no such supervision exists, and the middle and upper class boys and girls of the period are allowed to be packed away in close, ill-ventilated, badly arranged apartments, without any controlling authority, in premises not originally constructed for educational purposes, and with none of the appliances common to every Board school. A private house, originally intended for the accommodation of less than a dozen persons, is seized upon for a middle-class school for several hundred pupils.

Properly certificated teachers are demanded for primary tuition, but any speculative person, whether certificated or not, may establish a secondary school; and no Minister of Education may interfere with the glorious independence of the bold Briton who, perchance, may add to his intellectual incapacity entire ignorance of sanitary laws, the consequent effect of which upon the physical and mental vigour of his pupils, however deleterious, passes unchallenged.

Mr. Matthew Arnold has well said:—

"The middle classes in England have every reason not to rest content with their private schools; the State can do a great deal better for them. By giving to schools for these classes a public character, it can bring the instruction in these under a criticism which the knowledge of these classes is not in itself at present able to supply: thus, the middle classes might, by the aid of the State, better their instruction, while still keeping its cost moderate. This in itself would be a gain, but this gain would be nothing in comparison with that of acquiring the sense of belonging to great and honourable seats of learning, and of breathing in their youth the air of the best culture of their nation. This sense would be an educational influence for them of the highest value; it would really augment their self-respect and moral force; it would truly fuse them with the class above, and tend to bring about for them the equality they desire."

How this desirable end may be brought about, it concerns us all to inquire. I can do no more, on the present occasion, than call attention to it, in the hope that it may yet receive the consideration it demands from a patriotic people.

The recent growth of intelligence in the design and construction of national schools, and their appliances, is too obvious to need more than a passing remark, when comparison is made between the latest efforts of the London School Board and the system which preceded it. The effect of this improvement is, however, beginning to be felt in secondary schools; and its influence will be still more marked in the future, as time rolls on, and the necessity for the same constructional advantages is better understood and appreciated.

Humble as yet may be the educational results of the London School Board curriculum beyond the three R's, the social and moral influences of their

ample provision of space, suitable fittings, and sanitary arrangements, cannot be otherwise than considerable.

The older educational endowments for higher education are associated with buildings erected at a period when sanitary laws were little understood. As Mr. Robson observes:—

"Our old foundation grammar schools furnish us with few ideas as to the future planning of public middle schools; their sole provision was usually a single lofty and noble hall of oblong form, in which the whole of the boys might be seen engaged in their various lessons, learning by 'art,' or carefully plodding with grammar and dictionary within sight of the master, who was placed on a raised platform. No class room ever, until quite recent years, spoiled the simple dignity of these architecturally excellent school-houses, and their fittings were of the rudest and simplest kind."

Through the action of the Endowment Commissioners, many of these old institutions are being remodelled, and schemes for their wider use and development are constantly being thought out, as new buildings are required to meet the increasing demands for space. Opportunity is thus occasionally given to exercise the ingenuity which has been so well displayed in primary school-houses, on middle-class school buildings.

Private schools in particular, as we have already observed, usually suffer from the disadvantages of being located in houses not specially constructed for them. Public schools will inevitably become more and more popular as the teaching power improves, and as the opportunity for proper classification—which is increased with the larger numbers to be taught in one and the same building—is recognised. Public schools for boys have always been more or less in vogue, but public schools for girls are a modern innovation, calling for special contrivance in the buildings appointed for their use.

Concerning public day-schools for girls, and with respect to their suitability for the purposes contemplated, Miss Wolstenholme emphatically says:—

"The experiment of large day-schools has been successfully tried, and the results are conclusive as to the superiority of the system from whatever point of view we regard it; their superior economy is obvious. Morally, we believe the gain to be also great. We want, in every considerable town in England, a high school for girls, which should offer the best possible education on moderate terms—one which should serve as a model to all those private establishments for which in future, as at present, there will no doubt be abundant room. To such a school as this it would be very easy to attach all manner of appliances and apparatus in the way of lectures and special classes, which might be attended from private families or smaller schools."

Since these words were penned, eighteen schools for girls have been established by the Girls' Public Day-schools Company, originated by Mrs. Gray, who sagaciously hit upon this commercial means of extending this new system of education for girls. The system, however, is equally applicable to boys, and a Boys' Public Day-school Company would not fail to achieve a similar success.

The resources of the company have, as yet, been chiefly employed in the establishment of new schools, and they have been obliged to hire houses for school buildings. Except at Croydon and Blackheath, which are very creditable examples, I am not aware that they have erected any new schools. At Gateshead and Oxford new schools are projected.

I am, myself, engaged in the preparation of plans for a new school-house for the St. John's-wood branch, of which I was one of the original promoters, and in which I am desirous of giving an inexpensive illustration of the principles hereafter advocated, adapted to a school for 300 pupils.

The system of teaching adopted in these schools is very similar to that elaborated at those which may be regarded as the mothers of girls' day-schools, viz., the North London Collegiate and Camden School for Girls, founded by Miss Buss nearly 30 years ago. The remarkable success of these day-schools is proverbial. They now contain nearly 1,000 pupils, several hundreds more patiently awaiting their turn for admission as vacancies occur.

On the application of the Brewers' Company, the Charity Commissioners projected a scheme whereby certain valuable educational endowments, belonging to that company and the Clothworkers' Company, have been devoted to the development of these schools, thus enabling the trustees, to whom Miss Buss had handed them over, to erect, for her foundation, representative buildings of their class.

As the architect to the trustees for carrying on the said day-schools, I shall have occasion to point out the peculiarities of their construction, the drawings of which are exhibited on the walls, as is also my design for the Harper Trust Girls' Day-school, at Bedford.

With these preliminary remarks, I now proceed to offer some practical suggestions, with the view of popularising a subject not, generally, too well understood. It may be convenient if I arrange what I wish to say under two general heads:—

1. The general arrangement of the buildings as a whole.
2. The particular planning of the parts.

Part I.

We will take it for granted, if you please, that the site is all we could desire, with a hard gravel subsoil, slightly elevated, well drained, surrounded by play-grounds, chiefly extended towards the sunny side, the aspect being such that a few northern-lighted rooms may be obtained for artistic purposes; but the main class-rooms to be east by south, or west by north, that they may not be too cold in winter, nor too warm in summer, and may at all times be bright and cheery. The class-room windows to be not less than 50 feet from any opposite buildings, and their area of light not less than one-fourth of the floor-space, and, if the windows are on one side wall, the opposite wall should not be more than 25 feet distant, so that the farthest desk may have sufficient light; 15 square feet is the maximum area required for each pupil, and 14 feet a maximum height; the minimum area should be 12 square feet, and 12 feet height. Inlets for fresh air should be opposite the foul-air extracts, arranged for use in the varying proportions required in summer and winter, and entirely under the control of the teacher; some, at least, of the extract-shafts to be heated at the base, and some, at least, of the inlets for fresh air to be capable of being warmed on its passage into the room.

However contracted the site, it is to be hoped that room will be found for a fives-court, and for the simpler kind of gymnastic exercises, both covered and uncovered.

With reference to the general arrangement of school buildings, they naturally divide themselves into two distinct classes, viz., boarding-schools and day-schools.

Boarding-schools.—With reference to the first, it is not my intention to say very much, because it is not in this direction that the extension of educational buildings is likely to be very greatly increased; nevertheless, it is very important that the improvements made in day-schools should be imported into boarding-schools, and that the accommodation required for residentiary purposes should not overbear or prejudicially influence the educational department and appliances.

It has been one of the drawbacks to the proper development of voluntary schools, that the promoters were too often willing to sacrifice the school conveniences for the sake of obtaining space for popular lectures and general assembly rooms, and the Education Department very properly set their faces against innovations of this sort wherever their influence extended. At the same time, the great cost of extensive dormitories and domestic offices in boarding-schools renders it essentially necessary to bear in mind the double purpose of such buildings, so that each may be economically arranged, and the provisions necessary for the one purpose may not lead either to curtailment or extension beyond the requirements of the other.

As an example of the kind of building which, in practice, has been found to answer the ends proposed, I will draw your attention to the plans on the walls, which illustrate Milton-mount College, Gravesend. The educational division of the building occupies the ground floor of the main block, consisting of a southern front and eastern and western wings, over which are two stories of dormitories; the dining-hall – a single-storey building, with an open timbered roof—is situated in the centre, and is placed at right angles with the main building, and, being situated immediately opposite the entrance-hall, is easily accessible for public uses or school lectures and examinations, while at the other and northern end are the kitchen offices, quite distinct from the rest of the building, yet closely associated therewith by the corridor running on the side of the hall. The pupils' staircases occupy the internal angles at the junction of the main building with the wings, while in the centre is a service staircase, at the southern end of the corridor, connecting the main building with the domestic offices.

By this arrangement, the several parts of the building are in close connection and yet perfectly distinct:—The educational apartments, with the teachers' and pupils' dormitories above them; the kitchen offices, with the servants' dormitories over them; and the dining and lecture-hall between.

The architect of the London School Board, Mr. E. R. Robson, F.S.A., in his admirable work on school architecture, has chosen this building as an example of a middle-class boarding-school, and has given four illustrations of it. I cannot do better than quote his succinct description. He says:—

"Milton-mount College, Gravesend, intended for the daughters of Congregational ministers, and erected from the designs of Mr. Robins, forms a rare specimen of a carefully-considered school-house for 150 girls on the boarding principle. The sleeping apartments on the first floor are planned on the model of the ancient monastic dormitories, a central corridor down a large hall or room, leading, on right and left, to cells, chambers, or cubicles, formed by wooden-panelled or match-boarded partitions, 6 ft. 6 in. high, arranged along both sides.

"The monks' dormitory at Durham, erected in the 15th century, and now used as a library, was identical with this in plan. The advantage of the arrangement is that each scholar has a room to herself, while ventilation is promoted by the upper part of the room being entirely unencumbered by divisions. The cubicles measure 9 ft. 6 in. by 5 ft. 6 in., and occasionally two are thrown together, by the omission of the partition, for occupation by two sisters or friends. A drawing shows an interior view, supposing the partition removed for the purposes of a sketch.

"On the ground floor are the school-rooms, class-rooms, teachers' and visitors' rooms, library and music-rooms; the last are fitted with shelves and portfolio-lockers. The little practising-rooms each contain a piano, and it is found that sound from room to room is sufficiently deadened by the plan for the purpose in view. In each of the school-rooms book-closets are formed against the wall-dado, and surround the room.

"One school-room is fitted with a raised gallery and Dr. Leibricch's desks; there are four class rooms, each for 20 pupils; the bonnet and cloak-rooms are fitted with separate closets for every three girls; the dining-hall is capable of accommodating 150 girls and eight mistresses.

"The arrangements of the dormitories on the second floor are identical with those of the first floor."

Now there is nothing in the design of this building which would not make it equally suitable for boys, excepting only the music-rooms, which might be converted into science class-rooms. The same may be said of another example of this description of building, viz., the Educational Home for the Daughters of Missionaries, Sevenoaks, now in course of erection, the foundation-stone of which was laid by the Right Hon. W. E. Forster, M.P.

In this building I have carried out the same principle of planning, but so varied as to suit the special circumstances of the case, as may be seen by the drawings exhibited. In this boarding-school 100 children have to be accommodated and divided into senior and junior schools, the senior occupying the left wing and the junior the right. Cubicles are provided in the dormitories for the seniors, but not for the juniors, for which latter class nurses' rooms are required, and bath-rooms for all.

The dining-hall is in the same relative position as at Milton-mount College, with the kitchen offices and servants' dormitories in the rear; but in this case, and in consequence of the delicacy of children, born mostly in foreign countries, it was thought desirable to form the building into a quadrangular shape, with internal courts on either side of the dining-hall, so as to be less exposed to northern winds, and more compact and warm, the corridors themselves being heated. Both here and at Milton-mount ample space is given for cloak-rooms and conveniences, which, in each case, are projected from the main building, under lean-to roofs, towards the internal courts. An unwise economy usually contracts the space allotted to cloak-rooms, lavatories, &c., so as to make them greater nuisances than conveniences.

The plans exhibited sufficiently explain themselves, and will render any tedious description unnecessary; for the same reason, I do not think it desirable to detain you by describing the Misses Lushington's mixed middle-class school at Kingsley, opened by Lord Selborne and Mr. W. E. Forster, which is similar, but, for economical reasons, the kitchen offices occupy a different position, to enable a pair of existing cottages to be brought into use.

Day-schools.—We now come to the general arrangement of middle day-schools. In considering these, it will be useful to observe the recent growth of elementary schools; for this purpose, I have exhibited drawings of Christ Church Schools, Battersea, which were erected by me many years ago for 600 children—200 boys, 200 girls, and 200 infants; they were designed on the old system then required by the Education Department, and consisted of one long room and one class-room to each division, the classes in the long room being divided by curtains drawn out at right angles from the walls. This school was erected at the then stipulated cost of £4 per head, exclusive of the two teachers' houses.

On the establishment of the London School Board, many architects were engaged on the first schools projected, one of which fell to my share, viz., the Wapping School. The improvements very early made by the School Board are exhibited in this design for a school for girls and infants only, as shown in the more compact planning, the increase in class-room accommodation, and the introduction of dual desks, &c.

This tendency towards the increase of class-room accommodation is in accordance with German examples, and one of the most approved by Mr. Watson and Sir Charles Reed is Haverstock-hill School, designed by Mr. Robson. In this case there are four class-rooms to each large school-room, all of which are on the ground floor, each of the large school-rooms giving space for as many desks as the four class-rooms belonging to it together contain; but with this striking peculiarity, that the central space, around which these school and class-rooms are arranged, is covered, and forms a hall of assembly, wherein the whole school meets daily, and in which examinations can be held, and through which access is gained to all the classes, the glazed doors to each of these being commanded from the dais in the hall. This hall was originally designed as a girls' covered play-ground, and is so described in Mr. Robson's book, but experience has proved its great convenience in administration, and it is no longer used as a play-room, but contributes not a little to the educational success of the institution, at which my wife is a visitor. The "hall-passage system" had thus an accidental birth.

In Jonson-street School, Stepney, designed by Thomas Roger Smith, the large school-rooms were thrown aside altogether, and the one great hall alone retained, with separate class-rooms surrounding it on three sides, and all in direct communication with it. This school was professedly based on the Prussian system, but is a great improvement upon it, and is the best example of what Dr. Abbott has happily termed the "hall-passage system," adapted to schools of more than one storey in height. I look upon this as the culminating point to which primary school buildings have grown, and I take this as the starting-point from which progress is to be made in the future development of secondary schools. That I am justified in this opinion the latest design for a secondary day-school, by both these gentlemen is confirmatory. And, through their kindness, I am enabled to show you Mr. T. Roger Smith's design for the Grocers' School, and Mr. E. R. Robson's design for the Blackheath School, of the Public Day-schools Company, both of whom have adopted the said "hall-passage system" in these middle-class schools, the one for boys and the other for girls.

Mr. Henry Clutton has also adopted the same principle in his design for St. Francis Xavier's College, at Liverpool, erected, in 1875, as a middle-class day-school for 500 boys.

The advantage of so planning a school building that the head master may, with the least loss of time and trouble, have the whole school under his supervision and control, must be manifest to every one who thinks of the difficulty of personally controlling a school of 500 or 1,000 pupils and their various masters. A hall into which every class-room door shall open, where the pupils may congregate for prayers, for lectures, for examination, for separate instruction in such groups as may be required by special circumstances, where they may meet and retire in an orderly manner to their several classes or to their homes, under the eye of the presiding genius of the school, is obviously an addition of no small importance to the welfare and discipline of the school.

The moment that you introduce the corridor you destroy the possibility of exercising the same kind of influence; the hall, if you have one, becomes a costly appendage, of a stately character, but of no daily practical use, reserved only for special occasions. The teaching being done in the class-rooms, it has not the excuse for its existence which the old foundation schools had, for in them no class-rooms were provided.

For these reasons, I prefer Mr. Smith's design for the Grocers' School to that which has been chosen and erected, a plan of which I exhibit, and by which it will be seen that the hall is carefully cut off from the class-rooms by a corridor, which effectually isolates it, and gives to the head master no personal control whatever of the movements of the school, as a whole, from such a vantage ground, and thus the hall is rendered an expensive and comparatively useless luxury.

In designing the buildings required for the North London Collegiate School, at Sandall-road, Camden-town, and the Camden School for Girls, at Prince of Wales's-road, Kentish-town, I laboured under the disadvantage of having to incorporate therewith existing buildings in each case, and in the former to complete the new portion before I touched the old, so that the pupils might be transferred from the one to the other; but, feeling very strongly the representative character of these schools, I endeavoured to bring them into subjection to the latest, and, as I think, the best improvements in school planning. The task has been a difficult one, but success seems to be assured, even before the amended old part of the building has been entirely handed over for occupation, as in the case of the Sandall-road School.

Camden Schools.—The plans on the wall illustrate

the general arrangements, concerning which I may remark that the Camden School was first built and finished. The freehold of the Governesses' Institution, founded by Mr. Laing, was purchased for £5,500, and, at a cost of some £7,500, was adapted to the uses of the school. In this case, for economical reasons, no hall was desired, it being determined that the Clothworkers'-hall at the Collegiate School should be jointly used by the two schools on prize days, &c.

The education given at this school is at a much lower rate than the former, and the classes number 50 pupils in each; on the ground and first floors there are nine such class-rooms, a gymnasium, a drawing-school, a lecture-room, library and committee room, teachers' rooms, office, and caretaker's apartments; in the basement are the extensive cloak-rooms, drying closets, dining-room, kitchen, and domestic offices.

The girls enter by the basement steps on each side, proceed to the cloak-rooms, thence pass up to their several class-rooms, where each has a separate desk to herself; the use of the gymnasium, drawing-school, lecture-room, and playground being timed with great precision. Both hot water and open fire-stoves are used for heating and for drying clothes, and every class-room has arrangements for admitting fresh, and extracting foul air, independently of the windows. Owing to the administrative abilities of the head mistress, Miss Elford, no less than the completeness of the arrangements, this school goes like clockwork.

North London Collegiate Schools.—The old portion of the North London Collegiate School for Girls was originally an emporium, or general store, and was adapted by me for school uses. It is now undergoing considerable alteration and addition, an extra floor and a new façade being constructed. The new buildings occupying the remaining portion of the site are finished, and were opened by the Prince and Princess of Wales last July.

It will be seen by the plans exhibited that the accommodation comprises the following:—

The great hall, presented by the Clothworkers' Company, and called by their name, 70 ft. by 39 ft., and 32 ft. high, with a wide gallery at the end and a shallow one on the side at the level of the first floor, the raised dais and organ recess being at the opposite end on the ground floor. Three storeys of class-rooms are arranged on one side of the hall. The five class-rooms on the ground floor, and those over them on the first floor, are in direct communication with the hall by the ground floor of hall and the side gallery on each floor. Two of the class-rooms may be thrown into one, by opening the sliding doors provided between them. There are three class-rooms on the second floor and a large drawing-school lit in a similar manner to the Gloucester Art School.

Under the hall is the dining-hall, and the kitchen, scullery, and housekeeper's room; under the class-rooms are the cloak-rooms and conveniences, the store-room, the teachers' room, the strong-room, the head mistress's retiring-room, and the drying-room.

The basement and staircase are heated with fresh warm air by hot-water pipes in channels, to which fresh air is admitted in large quantities. The class-rooms have Boyd's School Board ventilating grates and fresh air admission shafts, and foul air extraction shafts are everywhere; so that the necessity for opening windows is not felt, though cross ventilation by windows is easily attainable, not only by the fanlights over the doors to the hall, but by windows in the same intermediate wall. The triangular space over the boarded ceiling of the great hall forms a warm air extraction shaft, hot-water pipes being placed at the foot of a vertical flue at one end.

There are two staircases to this new building, one at each end of the corridor. This portion of the school has been in occupation some eight months, and the advantages of the system have been fully proved; otherwise, in spite of the known administrative ability of the head mistress, it would have been impossible to have accommodated the whole school of upwards of 400 pupils without the use of the old part of the building.

It is an interesting sight to see the pupils come in through the basement entrance to the cloak-rooms, where they enter at one door and retire at another, changing their shoes as well as leaving their hats and cloaks, and passing up the staircases to the great hall, where they file in to their accustomed seats and await the organ peal giving forth the morning hymn, followed by the prayers read by the head mistress, at whose command each teacher leads her class to its class-room; after which the doors are shut, and work begins within and also without, in the great hall and gallery, which, at present, supplement the class-rooms in the old building not yet handed over, but about to be so next term.

The Old Building.—On either side of the main entrance to the old building are small triangular offices, at which inquiries may be made without further entering the building, at small windows provided; beyond these, on one side, are the head mistress's rooms, and on the other side, the general office and waiting-room; adjoining this is the board-room, which is also the library and museum. Over the board-room, on the first floor, is the science lecture-room, with a chemical laboratory adjoining; the other two rooms are respectively a class-room and the teachers' retiring room and library. The old staircase is retained to reach this floor, but the new staircase gives access to the second floor, in which are two large and five smaller class-rooms, for music-lessons and practice. The caretaker's rooms are reached by a special staircase, and extend from the front under the turret to the back; a box-room is situated in the turret itself, and a lumber-room in the general roof. Behind the organ are passages on each floor, and a lift from the sub-basement and coal-cellar to the lift and cistern-room on the top-most floor. Two drinking fountains are provided for each floor, supplied with filtered water, and lavatories and w.c.'s in addition to those entered from the cloak-room. The basement is occupied by a cloak-room 30 feet square, a cooking school and scullery, &c.

It must be confessed that, upon this very awkwardly shaped site, very little else could have been done had the buildings been re-built instead of only enlarged. The playground is much too small, and is partly occupied by the gymnasium, which is fitted with Stempel's apparatus; a fives-court is to be attached to the gable-end wall.

Such is a general description of these schools. I now come to consider one twice the size, which has recently been the subject of much discussion, viz., the City of London School.

I have exhibited on the walls my competition design for this building, in which you will see a further development of the same principle of planning which I have been advocating, but which was as fatal to my success as to Mr. Smith's in the Grocers' School competition. The public has not yet been educated up to the "hall-passage system," and the selected plan in this competition repeats what I considered a defect in the former case—the great hall is made a solitary apartment, carefully cut off from the uses of the school by the corridors surrounding it. In other respects the plan is suited to the site, but would be as complete without the hall as with it.

In the design submitted by me, the hall is the centre of civilisation to the school; into it every door to every room in the building opens, and from the dais is commanded every part of the building and all the people in it. This hall is lit like the nave of a church, with a range of clerestorey windows above the roofs of the class-rooms surrounding it. It takes away the necessity for close, stuffy, dark and dreary passages, and gives a cheerful hall and promoter of light and ventilation. It has a gallery round it, at the level of the first and topmost floor. The class-rooms on three sides open into it, and the great lecture-room for 400 students is at one end, in easy communication with the chemical laboratories and class-rooms.

Under the lecture-room on the ground floor is the dining-room, capable of being divided into four class-rooms, and supplied by a lift from the kitchen on the second floor, which is part of the caretaker's apartments.

Benches are provided for the whole of the school on the ground floor, with aisles 10 ft. wide running round and forming open passages of communication, never needing to be screened by curtains except on examination days, as experience has proved at Sandall-road School,

The head master's and secretary's room, the clerks' offices, and the board-room, with the separate waiting-rooms, are ranged on either side of the chief entrance from the Embankment.

The basement is almost entirely devoted to covered playgrounds and cellarage, the fives-courts and conveniences being planned carefully with covered ways to the latter from the staircases.

The head master's private room overlooks the south-western corner, and the teachers' private common-room overlooks the playground at the north-west corner, so that out of school the masters are in the best position for observing the pastimes.

Mr. T. R. Smith's design for the Grocers' School is most compact, and a glance at the drawings makes the arrangements quite clear, leaving little by way of description necessary. The class-rooms are arranged on three sides of the hall, with which they are in direct communication, similar to the admirable Board school erected by him at Stepney.

Mr. Clutton's design for St. Xavier's College, already referred to, is also well illustrated by the plans and sections which he has kindly lent me. I was not aware of its existence till, in searching for corroborative examples of the principles I am advocating, I found an illustration of it in the *Building News*. I wrote to the master to learn what his opinion is of the practical advantages to be gained from this arrangement, and the Rev. Father Harris replies as follows:—

"The opening of the class-rooms directly into the great hall has very great advantages. 1st, as regards general supervision; 2nd, as regards saving of time; 3rd, as regards all general discipline. It is, however, difficult to use the hall for any general purpose during school hours; but, as far as the good of the boys, which is the principal matter to be studied in a college, is concerned, the system answers admirably."

I have also received the following note from Miss Buss, whose testimony is of great value:—

"During the time that we have had the use of the hall, we have found it exceedingly pleasant. The opening of the school-rooms directly out of the hall is certainly a great advantage. The supervision is much more easy, as is also the control of pupils while assembling and dismissing. The light and ventilation are excellent, far better and more complete than they would have been if you had given us a separate passage."

Part II.

I now proceed to consider the second formal division of my subject, viz., the particular planning of the parts; but I fear the time at my disposal will necessitate a very limited discussion of the details.

The Lavatory and Cloak-rooms.—Every school is, or ought to be, entered through the hat and cloak-rooms, and the most convenient mode of retirement should also be by the same route, supposing always that the cloak-room does not form a separate adjunct to each class-room, as in the case of the City of London School. In this design I endeavoured to realise the expressed wishes of the head master, and arranged for the boys' entry into the cloak-room on one side of each class-room and out at the other, the custom at the dismission being for the master to order the boys to file off from their class-seats into the cloak-room, and enter again by another door to their seats, with the hats and coats with them; when all are ready, the order is given to leave; in this way the loss of clothes is prevented. But the better plan is to have separate cloak-rooms, which may be heated and ventilated quite independently of the class-room, and may also be dried by hot-water pipes as they hang, or, if very wet, taken to the drying-room. One of the most complete cloak-rooms, as well as the most extensive, in a boys' school of this kind, is that of Cowper-street School, Finsbury. And, I am sorry to say, about the worst, are those provided in Board schools, where, if anywhere, it surely is most necessary to avoid the transmission of disease and other evils, by providing cloak-rooms of sufficient size, and not, as is most common, having two or more rows of pegs over each other, so that the garments hang one upon another; but the outcry against expenditure in Board schools will, doubtless, make it difficult to improve in this respect.

In secondary schools, however, this ought not so to be, and yet it is the commonest sin in the most elaborate and expensive buildings in other respects, and not less in girls' than in boys' schools.

The provision made in the North London and Camden Schools is as economical as it is efficient, and the plan is this:—The cloak-rooms are situated in the basement, and consist of a series of rooms

the same size as the class-rooms above them, surrounded on all sides with a single row of pegs, not less than 9 inches apart, a shoe-rack, and umbrella hook, with continuous metal water-channels, made movable in short lengths.

A screen down the centre gives space for a similar arrangement on either side; hot-water pipes pass under each screen, above the floor; between the rows, forms are placed for the girls to take off their walking-shoes; every peg is numbered, and every pupil has her number.

The lavatories are situated in the cloak-rooms, and the external conveniences are entered from the cloak-room; so that every arrangement is open to inspection, and under the control of the teachers on duty in each room. Some teachers prefer to keep the lavatories and conveniences separate from the cloak-rooms, so that the cloak-rooms may be locked up during school hours.

In boarding-schools it is usual to provide closets and doors with looking-glasses in the upper panels, &c.; but, in all cases, plenty of room is essential to the discipline and *morale* of the school.

The Class-rooms.—The arrangement of the class-rooms is one of the most important of the parts. The number of scholars varies with the system of classification adopted.

The Public Day-school Company prefer from 20 to 25 in a class; the North London Collegiate School, for the higher education, apportions 30 to a class; the Camden School has classes of 50; a common number is 40, which is that adopted at the City of London School, but 60 is not an unusual number in great schools.

Continuous forms and desks, four, five, and six rows deep, are usual, but I prefer the dual desk to the continuous, and think the best arrangement is that adopted at the North London and Camden Schools, where each student has a single Swedish desk, set 15 or 16 inches apart, so as to allow of a passage between each from front to back; the rows will then need no space between them from side to side, but a 2 ft. passage or more is desirable at the sides next the wall, though not essential, the resulting area being from 12 to 15 ft. each scholar. In all cases, the light should fall on the left side of the desks; and, if the rooms are not heated by warm-water pipes, the fires should be opposite the desks; and not in the centre of the wall, but between the teacher's desk and the entrance door, so that the teacher's raised desk may stand in the centre, and the draught, if any, from the door may only feed the fire, without annoying the teacher or the students.

On the opposite side to the fire, and behind the students' desks, vitiated air extract shafts should be built in the walls, with a large grating fitted with a gas jet inside, and the means of closing, if desired, one at each side and close to the ceiling. The stoves should be on the principle of Boyd's School Board stoves, with fresh air passing through them into the room. Further fresh air shafts, on what is known as Tobin's system, may be added, if desired, or by shafts in the wall, under window sills, opening through hit-and-miss ventilating gratings fixed in the window-boards. The latter is adopted at Sandall-road, but has the disadvantage of admitting the air too low, and the descending cooler air, next the cold window panes, checks the upward current of the inlets. The wall opposite the windows, in which is the door, should be supplied with a large fanlight over the door, and corresponding dwarf window openings in the upper part of the wall, so that cross ventilation may be obtained at pleasure, and particularly in the intervals of teaching. The rooms should be 13 or 14 feet high, as wisely required in all Board schools. Class-rooms so designed and arranged on one, two, or three sides of the great hall, form the largest part of the school buildings, and are adapted to every purpose required. Examples of such class-rooms are given.

Drawing Class-rooms.—In addition to a northern light, a high light is desirable; and not only so, but a skylight also; and this is best attained by a curved roof, similar to that adopted at the Gloucester Fine Art School, and to that which I have built for the North London School. In this case, I have formed the roof with iron ribs and sash bars on one side, and glazed it like a conservatory, lining with boarding so much of the interior as the circumstances of the case required by actual experiment. The drawing exhibited will best illustrate this.

Science Class-rooms.—I have already referred to the great changes which have recently taken place in school buildings, the single lofty hall which constituted the whole school 50 years ago being now superseded by a variety of separate class-rooms and other conveniences. But this change in the architecture has been accompanied by a yet more marked revolution in the mode of teaching, and in the matter taught. The education of the memory, which was all that was provided for our fathers, is in these latter days giving place to the education of the mind. To develop the reasoning faculty is now considered a nobler task than to manufacture walking encyclopædias, and, since it is now generally accepted that one of the most powerfu instruments for the cultivation of the reason is the study of science, it is evident that chemical and physical laboratories—and, possibly, even mechanical laboratories—will henceforth be considered essential parts of a first-rate secondary school.

These laboratories will also be associated with one or more lecture-rooms to accommodate from one to four hundred students, or from a third to half the school, if not exceeding 800; above that number, it is better to have two lecture-rooms.

The particular form of chemical operating stalls, the service of gas and water, the sand-baths, and the fume-closets, are illustrated in drawings on the walls, and may be further studied by reference to the published illustrations of the admirable laboratories at Owens' College, Manchester; but, as I am not aware that similar publicity has been given to physical laboratory fittings, I have exhibited on the walls a few illustrations of the very clever arrangements designed by Professor Ayrton for the college at Yedo in Japan, which his kindness has put at my disposal.

I may, however, remark that the chemical laboratory operating stall should be from three to four feet wide and two feet three inches deep, with two tiers of bottle-shelves at the back, two gas jets with Bunsen's burners, a bason of lead or of stoneware; the latter is less affected by acids, but the former is easily repaired or renewed, and fewer breakages occur in its use. If the laboratory is small, one sink in the corner, or next walls will be all-sufficient, as at Sandall-road. Different sized drawers are required under the oak table top,

and the remaining space may be provided with shelves, with doors to enclose the same, set back to allow space for knees when sitting at the stall.

The fume-closets should be formed with lead-lined sink and closet under, enclosed with panelling (if not recessed in the wall), with rising sashes in front; in the bottom rail of the lower sash hit-and-miss ventilators should be fixed, to admit air from the room to the chamber, at the upper part of which is a ring of gas jets at the foot of an extract flue.

A better plan is adopted at Owens College. All the fume and exhaust closets are connected by channels with a lofty chimney, at the base of which a furnace is constantly burning, and the draught created by this sucks up the air from the fume-closets and carries it far above the buildings. A director's room, best apparatus-room, balance-room, and special operation rooms are desirable additions.

Since writing the above passage, I have received from the Science and Art Department of the Committee of Council on Education at South Kensington, their science form, No. 1013, descriptive of fittings for laboratories; and with it a series of drawings, which I have exhibited on the walls; but as, on the payment of 1s. 6d., any one may obtain a copy of these documents, I will not detain you by a description now, except to say that they are the result of much deliberation, and practical experience has proved their value. The Royal Institute at Hull is fitted up with these fittings, which are suitable for advanced classes. The Gloucester and the Watford Art and Science Schools are illustrated in Colonel Donnelly's reports, and may be consulted there. These buildings aptly illustrate what is required to complete secondary school buildings. Their existence as separate institutions proves that the want has been felt and provided for in this way; in future buildings the want should be anticipated. The chemical and physical laboratories—designed for the Cowper-street Technical School of the London Guilds' Institute—are fully described and illustrated in the report of the Governors of the 10th of March last; and since any one interested in the subject may obtain a copy on application to the secretaries of the Institute, I abstain from entering upon any description of them, but at once proceed to the consideration of—

The Physical Department of the Imperial College of Engineering at Yedo, Japan.—From the particulars given to me by Professor Ayrton, I have been enabled to prepare a ground plan of the department of which he was professor, and it is no small satisfaction to me, as a member of the Executive Committee of the City and Guilds Technical Institute, that his able services have been secured to develop the physics classes at Cowper-street, for which costly buildings are in course of realisation, such as it is hoped may give full play to his talents, to the great advantage of the youth and working classes of the City of London.

Room No. 1 is the demonstration room, 50 feet square, and occupying the whole height of this portion of the building, which is shown in the exterior perspective view of the same. It was fitted up in the following manner:—On a level with the first floor, a gallery about 3 ft. wide ran round the whole room, from which wires and other apparatus were suspended for experiments; it also gave access to the shutters by which the upper windows could be closed to darken the room for optical and other experiments. The students' benches occupied the centre of the room, and around three sides of the room, next the walls on the ground floor level, were instrument and working cases, the under side of the gallery being utilised for cupboards, entered from behind.

Room No. 2 is the general laboratory, fitted-up with instrument cases, covered-in working cases, the tables being on concrete foundations, and uncovered instrument cases on brick piers.

Room No. 3 is the professor's private room and private laboratory.

Room No. 4 is the instrument room.

Rooms Nos. 5 and 6 are for electrical experiments, No. 5 being fitted up with six brick pillars, each about two feet square, and descending six feet into the ground. No. 6 has long tables on brick piers.

Room No. 7 is the lavatory attached to the laboratory, for washing bottles, &c.

Room No. 8 is a small, artificially-dried room, in which experiments with frictional electricity could be conveniently performed.

On the first floor, which extended over all but the demonstration-room, were rooms for experiments on light, a small class-room for the teaching of applied physics, rooms for special experiments, store-closets, and the battery-room.

The detail drawings, which I have had prepared from those made by Professor Ayrton, are exceedingly interesting and valuable on account of their originality, and because they have stood the test of use in the college at Yedo.

Fittings in Demonstration-room.—The sloping platform, or students' gallery, is shown on the drawings, and in the side sectional view I have indicated in dotted lines the brick piers which sustain the students' tables distinct from the general flooring, so as to be quite free from vibration. There is also a front, back, and top view of the students' benches, and a section showing sinks and gas-fittings.

By this special arrangement of students' benches (which is believed to be unique of its kind), it was possible for the students, without leaving their places, to repeat the experiments made by the professor during the lecture, with apparatus placed ready for them on these firm benches. Between the lectures, these benches or tables could be utilised as part of the laboratory proper.

Illustrations are also given of the instrument cases, with folding-doors and glass panels, as arranged around a portion of the demonstration-room, which are also used in the laboratory.

Details are shown of the professor's lecture-table in this room, resting on a platform, the whole of which was sustained on a concrete foundation distinct from the general flooring, and its fittings included a pneumatic trough sink.

Fittings in the Laboratory.—Besides the instrument cases, the drawings also exhibit the working cases, furnished with glazed sash windows, as used in the general laboratory and in the professor's private laboratory.

The tables in the cases rested on a concrete foundation, quite distinct from the flooring, to avoid the transmission of vibrations; so that, except where the sash was closed, after work, to exclude dust or meddling fingers, no part of the case rested on the table, there being no connection between

the table carrying the apparatus and the floor, on which rested the sash frames and glazed enclosure, and on which the experimenter stood. With such working cases a delicate investigation could be carried on from day to day, the apparatus being always ready whenever the experimenter had leisure to work at it. Some of the working cases, so enclosed and fitted with window sashes to exclude dust, &c., not being required for very delicate experiments likely to be spoiled by small vibrations, stood upon the common floor without concrete foundations.

There is the charm of novelty in these arrangements so far as I know, and of the following fittings for the battery-room.

Battery-room.—Illustrations are given of these designs as carried out in the aforesaid Technical College of Yedo, under Professor Ayrton's direction.

Accommodation was provided for about 200 Grove's cells and 300 Daniell's, used for general electrical work and for the electrical testing of the students of telegraph engineering. The peculiarity of these special fittings was that all the cells were under glazed covers, and, therefore, dust was excluded; yet all the cells were visible, and all obnoxious gases were led up the flues; the cells were easily got at by opening any portion of the double-hinged cover.

When taking a Grove's battery apart, after use, the zincs were put at once into the long, narrow leaden sink, immediately in front of the battery-stand; and the porous cells to soak in the long leaden sinks immediately behind the operator. After soaking, the porous cells were put on the racks to dry, and were ready for use within reach of the operator putting up the battery on the next occasion.

Of Professor Ayrton's drawings I have seen ten, and of these I have chosen the most interesting examples.

It is to be observed that the fittings of the physical department at Yedo were contrived to enable the students to learn by advancing the bounds of knowledge, and not merely by assimilating existing information, as is evidenced by numerous published accounts of original research conducted in that laboratory; and it is this method of teaching which has given to Professor Ayrton the *prestige* which he enjoys.

Now, I trust that I have not wearied you already, but I was anxious to take this opportunity to give publicity to a series of very ingenious contrivances, which I hope one day to see, more or less, realised in the higher class secondary schools of the country.

The need of technical knowledge, based on scientific principles, is daily becoming more apparent, and our secondary school teachers will find it to their own interest, no less than that of the middle classes generally, to give increasing attention to it.

In conclusion, while thanking you for the patient hearing you have given me, let me express a hope that buildings for secondary educational purposes will no longer be considered unimportant accessories to the fuller development of the teaching power of the master, and the acquiring capabilities of the students, and whether the authority of Government is applied to the removal of the present inconsistencies or not, that the good sense of the English people will in this, as in most other things upon which it exercises independent thought, achieve its own emancipation from the thraldom of habitual apathy and contented submission to things as it commonly finds them.

DISCUSSION.

The Chairman, in inviting discussion, said he felt sure that all who were interested in the great work of education must feel the extreme importance of having the arrangements suited to the work, and must appreciate, as he himself did, the able and thoughtful address which had just been delivered by Mr. Robins. He had been asked to submit a few remarks bearing not directly on the architect's question, but rather on the state of technical education at the present time, and with the permission of the meeting he would do so before the discussion upon the paper closed.

Mr. J. G. Fitch said the important matter always to be considered was, first, how to get the most effective teaching, and then how to adapt the mechanical arrangments to that teaching. Two or three things had struck him during the reading of the paper, which he should like to have considered by teachers, and by architects who built for teachers; one was that architects generally considered it sufficient if they provided a seat at a desk for every scholar; they built upon the theory that that was the scholar's place, and that he would seldom leave that seat; but his own feeling was, that in order to keep up the intellectual life and animation of a school, it was desirable that at least one lesson out of every three or four should be given standing. It was not desirable that children should remain seated during the whole of the time, and, therefore, he hoped that, in planning class-rooms, architects would remember that it was not wise to fill them up with desks, so as not to leave room for the scholars to take one lesson while standing. There was a great contention as to the character of the desks, whether they should be long continuous desks, dual desks—like those adopted by the School Board—or Swedish desks, in which the children had each a separate seat, like a chair. He was not going to try to settle this question, but he hoped those that did try would bear in mind that the comfort of the teacher in teaching had to be considered as well as the comfort of the scholar in sitting. The more you scattered the scholars over a wide area, the more you increased the difficulty of a teacher in getting the class into a proper focus. That seemed to be a great objection to the arrangements as proposed, because if the scholars were spread over too wide an area, the teacher could not teach effectively without a trying expenditure of voice. No doubt class-rooms should be in the main isolated from each other, and if the class consisted of 30 scholars, it was well that the teacher should have them all to himself; but he would remind architects that there were some lessons which could be given with advantage to two classes at the same time, and therefore it would be as well to have the class-rooms separated by a moveable partition. After all, it was the character of the teaching staff, and a proper consideration of the sort of subjects to be taught in separate rooms or not, which should be looked at in determining the construction and fitting of a school; and, therefore, he hoped teachers would consider that when they came into council with architects and others who looked at the matter from a purely mechanical point of view.

Mr. C. Mast thought that too much attention was paid to large schools, to the neglect of the smaller ones, in which the greater part of secondary education was taught. He hoped that the system of designing large schools would not be extended, because he believed that

the grouping of a great number of children under one roof was a bad plan. Every teacher would admit that, if his teaching was to be effective, he must act upon a small number, and though it was, no doubt, more economical to have large buildings, still the object of the teacher was better attained in a small room. He thought the desks ought to be moveable, and agreed with the last speaker that there was nothing more objectionable than the present system of giving all the lessons to the scholars while seated. The difficulty of arranging a school to meet the requirements of every master was no doubt, very great, but he thought every practical teacher would soon find the means of adopting a building to his purposes.

Mr. Roger Smith said he could not add much to the careful account which had been given of school buildings, as they were being designed and erected now; but, speaking as an architect, it struck him that a good deal was being done to give to buildings that kind of adaptation to the requirements of modern tuition which Mr. Fitch pointed out was necessary, and which he hinted architects hardly thought of sufficiently. But there was nothing which an architect was so pleased to get as the ideas of the person for whom he was building, and a definite account of the requirements to be met. The difficulty was not so much to provide for the requirements as to ascertain them thoroughly and consistently. He was glad to hear the advocacy which Mr. Robins gave to the system of class-rooms clustering round a central hall, without that abomination called a corridor; and he felt sure that a great many schools, even those for primary education, would be built on the improved system, and the number of class-rooms increased. There were one or two points with regard to class-rooms, which it might be desirable to dwell upon, not that they would be overlooked by men engaged in the construction of schools, but because upon occasions like the present hints might be thrown out which would bear fruit hereafter. Nothing should be neglected to make the class-room as good for its purpose as possible, and it should be made easy to hear and speak in. A perfectly square room was convenient for arrangement, but was not usually successful for hearing and speaking in; and, therefore, it was desirable that the room should be oblong, but not very far removed from a square. Then came the question how the children were to be ranged; were the windows to be at the end or the side of the room. The advantages and disadvantages were, briefly, these: if the children sat along the side of the room, they formed a wide group, but if at the end they formed a narrow group, and were more under the eye of the teacher. This arrangement would generally be found to be successful, besides having the advantage of a greater spread of light. Another point to be considered was that of having sufficient provision for ventilation. The difficulty of working and of teaching in a hot or close room was so great as to neutralise every other provision for comfort; and ill-designed rooms, if they were only thoroughly ventilated, would, in many cases, be more happy places to work in than the best-lighted rooms if they were allowed to become close. He felt sure that they had not yet reached the culminating point in the designs for schools; probably they would obtain greater simplicity, compactness, and completeness than they had hitherto reached, and in time a model would be produced capable of general adoption, though he did not flatter himself that any one had hit upon that model yet.

Mr. Wm. J. Spratling said, upon the subject of cloak-rooms, he might mention that, having had occasion to go over some plans for the enlargement of a secondary school, he found the architect had arranged for a long room, with forms for the children to sit upon to change their shoes, along the length of the room, the cloaks being hung upon each side of the form. It occurred to him that was rather inconvenient, because if there were a large number of children the crowding would be excessive, and he suggested that a corridor should be made down the centre, the sides being divided into cubicles, with a door in the centre, thereby obtaining a larger space upon which to hang the cloaks. Mr. Robins had suggested that the lavatories should be in the cloak-room, but he questioned whether it should be desirable to have them in a room where you wished to dry wet clothes, as children very often threw the water about the room. Architects seemed to take a class-room as a type, and said because a lecturer would stand in a room and have the black board behind him, therefore the room would be good for a class-room; but the teacher had to keep his audience in order, and if he had to turn his back to the class, little pranks would sure to be carried on. He thought it would be desirable that the teacher should stand at an angle, so that he might, when writing on the board, have his eye upon the class. As singing was generally taught in schools, it was important they should have a gallery, which might be used also upon occasions such as the distribution of prizes, when the children might be massed in the gallery, facing the chairman who distributed the prizes, the audience being in the middle of the room.

Professor Ayrton said, as Mr. Robins had referred to the physical department in Japan, he might, perhaps, be allowed to make a few remarks. It was pretty generally admitted that the only way to acquire a knowledge of a language was to hear it spoken, and that a grammatical study, however perfect, would not fit a person to converse with a foreigner. One could not be said to know a language until you spoke it properly, and to do this it was necessary to have a large amount of experimental practice; and as in the study of a language, so it was in the study of science. Advance in science must be brought about by the combination of mathematics and experiments, and he ventured to think that the same sort of course must be followed in teaching science. As a rule, boys and girls could only give a small portion of their time to experimental work; hence arose the important question, what sort of laboratory practice should they be set to; should they, for example, repeat the experiments, or, at any rate, some of the experiments which they had seen the lecturer perform. That was very good practice, no doubt, for teaching them the physical manipulation, and impressing on their minds the well-known laws of physics, but it was open to this objection, that in their experiments they would be aiming to arrive at the result given in the text-book, and not really searching for the true principles of the matter; they would be more inclined to manipulate the experiment, so as to agree with the book, than to acquire habits of scientific research. All young children were really experimental philosophers; they were always trying to find out something that they did not know. A very much better kind of experiment for boys and girls in laboratories, would be an experiment that had for its object the advancement, in some small degree at any rate, of existing knowledge.

Mr. Flux begged to call attention to the fact that they were met that evening to discuss a paper on school building, and he thought Professor Ayrton was going rather wide of the subject.

Prof. Ayrton said he was rather trying to come to the point how the building should be constructed to suit the education given in it; but if the meeting thought the question was too far apart from the subject before it, he would not proceed further.

The Chairman said the meeting would, no doubt, be glad to hear the outline of Prof. Ayrton's general ideas as well as their application.

Prof. Ayrton said he wished to show the necessity for

the architect and instructor going hand-in-hand in the designing of a physical laboratory. The illustrations on the wall of the laboratories at Yedo might seem, at first sight, to be complicated, if the object were simply for the purpose of repeating experiments; but if it were accepted that the more important branch of experimental work was the doing of original work by lads, then the necessity would be seen for not throwing difficulties in the way of students, by unsuitable accommodation, or by the necessary appliances not being forthcoming, because the difficulties inherent in any original investigation were quite large enough in themselves.

The Chairman said it was wished that the technical education to be given to the young people of the country, should be of such a kind as would prepare them for a useful career in life. It would lead them too far if he gave any outline of the various principles which had been proposed to guide a system of technical education, but he had recently formed, in his own mind, a notion which he should be glad to submit to the consideration of the meeting, and partly for the reason that it differed essentially from one which he had brought forward on other occasions, and which he was still inclined to think correct as far as it went. The technical education, which is now being taken up by the great and powerful corporations in the City of London, ought to do something really great. The rich can take care of themselves; they can easily get, more or less efficiently, the various good things of life, but the poorer classes cannot, and it is these whom it is most important to reach. What had been done up to the present time fell short of what was intended. Mechanics' institutes, as the name denoted, were intended to give education to the sons of mechanics, but they had not thoroughly succeeded. They had been useful, and successful to a great extent, but they were, in the main, attended by the middle classes. It was a difficult problem to solve what kind of instruction was suited to children of from 14 to 18; and in order to render what he was about to say more clear, he might contrast it with the opposite view which he had previously referred to. The general notion which was entertained of the most complete system of technical education, is that it should consist of two phases; first, a most thorough scientific teaching; and secondly, actual experience in the workshop. Of course, for the children of the poorer classes, it was utterly out of the question that they could have anything approaching a thoroughly scientific training and the difficulty was to see what could be done for them in that direction. The idea which had latterly been assuming shape in his mind was this, that it would be natural, and practical, to begin at the other end; not to begin, as was at present done in the higher schools, with science itself, but to begin with the workshops and factories. In the case of lads in factories performing operations which they did not understand, but which they had learned to do empirically, they might be taught by competent teachers, in laboratories fitted up at the works, the particular conditions upon which the success of their different operations depended; as, for instance, in the case of dyeing, they might be taught the common impurities, and how to detect and remove them; they should be taught just as much, and no more, of the scientific principles as was needed for the clear and accurate performance of the operation in which they were engaged. In some cases, this was already being done, as, for instance, in the art of brewing, where Dr. Graham had already instructed many pupils how to detect and remedy defects which had existed for years. The difficulty of doing this was, no doubt, enormous, owing to the fact of their not having the necessary teachers; and these teachers would have to be grown, so to speak, before the difficulty was overcome. For secondary training, he believed that laboratories were destined to occupy a more prominent place; in fact, that technical education for the masses would consist in teaching them, not merely to perform the operations of their respective trades, but to understand the nature of the conditions required for the success of those operations. In the interest of science, very great results might be anticipated from such work as he had described. He could hardly doubt that, if perfectly accurate, though not high, instruction were given to large numbers of the youth of working classes, many would be stimulated, from the delight of doing things in an accurate and intelligent way, in which they had never done them before, to educate themselves further by any available means. He trusted that what he had said was sufficient to render his general idea intelligible. The great thing to aim at was to give the lower classes an accurate knowledge of rudimentary scientific facts, so that they might, after a short time, be able to earn higher wages than they did now, and so encourage others to follow their example.

Mr. Robins, in reply, said he was indebted to Mr. Fitch for reminding him that he had not mentioned the fact that, in each of the schools described, it was provided that two or more class-rooms could be thrown into one; but he thought the charm of a separate class-room was that it gave the teacher a private room. He considered that single desks were very useful things under all circumstances, as you had more space in which to move about, and the books could also be kept in the desks. As to the remarks about the form of the class-room being oblong, he had found that a great difference of opinion upon this point existed among teachers, some preferring one shape and some another, depending very much upon their long or short-sightedness. And as to the acoustic proportion of the class-rooms, they were rarely of such dimensions as to cause any difficulty of hearing. Ventilation in schools was an important matter, but the architect must be treated with some tenderness, on account of the public not liking new inventions. It was quite a common thing to enter a class-room and find the ventilators closed, and he had often heard it remarked, that it would be as well if the ventilators were made so as not to close; but his own opinion was that the teachers ought to have the sole control of the ventilating apparatus, and to be interested in its success. He trusted that the valuable remarks of the Chairman would be well pondered, and exert that influence which they decidedly merited.

Upon the motion of the **Chairman**, a vote of thanks was voted to Mr. Robins, for his paper.

MISCELLANEOUS.

EXPLOSIVE AGENTS APPLIED TO INDUSTRIAL PURPOSES.

Prof. Abel, C.B., F.R.S., read a paper on this subject before the Institution of Civil Engineers, on the 23rd of March, in which he pointed out that, since this subject had been brought by him before the Institution in 1872, the advantages of explosives more violent in character than gunpowder, for many important industrial uses, had become so widely known and extensively utilised, that the supremacy of gunpowder, as the only practically, useful, and economical blasting agent, had for some time been a thing of the past. The greatly superior results furnished by dynamite, gun-cotton, and other explosive agents of the same class, when applied to work in which their rending and shattering action was valuable, had led to the replacement of powder by them in many directions. It had also had the effect of rendering miners more critical in regard to the quantity of blasting powder,

a result which had operated beneficially, not only by requiring the bestowal of greater care upon the manufacture of blasting powder, but also by leading to improvements in the nature and form of powder. An improved blasting powder of Messrs. Curtis and Harvey was referred to as one illustration of this. An account was given of the advantages attending the employment of compressed powder, in the form of the charges first devised by Messrs. Davey and Watson, and manufactured by Messrs. John Hall and Son, which were rapidly coming into extensive use, and which presented unquestionable advantages over granular powder, on the score of convenience and comparative safety, as well as of greater efficiency. Other improvements in the application of gunpowder having been referred to, the author proceeded to examine into the progress which had been made in the production and application of preparations of gun-cotton and nitro-glycerine, observing that but few of the many proposed substitutes for gunpowder, to which he had alluded in 1872, had received any important applications.

The advantages attending the employment of wet gun-cotton were described, and the manner in which its detonation was brought about was examined; the theory of the development of detonation, as distinguished from explosion, and of its transmission, being incidentally discussed. Various important technical applications of wet gun-cotton, dynamite, &c., were referred to, as illustrating the utilisation of the comparatively instantaneous character of detonation. It was pointed out that the safety, power, and comparative simplicity attending the application of wet gun-cotton to the larger operations for which violent explosives were valuable, had led to its adoption for submarine mines, torpedoes, and military engineering operations generally. On the other hand, compressed gun-cotton, employed either wet or dry, was now only used to a limited extent as a blasting agent, chiefly in the form of preparations sold under names by which their actual nature was disguised. Thus, a variety of nitrated gun-cotton, converted into compressed charges, similar to the original compressed pure and nitrated gun-cotton, was supplied to the miner under the name of tonite, and its employment as an efficient blasting agent was gradually extending. An account was given of the rapid progress which had been made in the application of the nitro-glycerine and Kieselguhr mixture, called dynamite, to the exclusion of other plastic nitro-glycerine preparations. The employment of dynamite upon a large scale was illustrated by reference to the stupendous operations connected with the destruction of the reef at Hell-gate, in East River, New York, when a total of 49,915 lbs. of dynamite and other nitro-glycerine preparations was exploded in one single operation. The objections to the employment of nitro-glycerine in the pure liquid state were pointed out. Reference was made to the tendency of dynamite to freeze, and the necessity for thawing it before use, as a prolific source of fatal accidents in connexion with mines and quarries, owing chiefly to recklessness of men, and their disregard of caution and instructions. In the course of the paper, the author referred repeatedly, and in strong terms, to the mischievous and frequently disastrous effects of misleading statements with respect to the safety of particular explosive agents, such as the absence of noxious gases in connexion with their use, &c., which had, from time to time, been published and circulated in mining districts by the manufacturers and vendors, and which not only engendered false ideas of safety, but also encouraged the natural tendency to disregard precautions.

An account was next given of a new class of nitro-glycerine preparations, devised by Nobel, of which the so-called blasting gelatine was a type, and which presented such decided advantages over dynamite in several directions, that they had already, to an important extent, supplanted it on the Continent, and promised to extend greatly the safe and efficient application of nitro-glycerine. In giving an account of the properties of blasting gelatine, and of certain difficulties which had to be overcome in its application, the author described a series of experiments he had made with the view of increasing the relative power, &c., of the more important explosive agents. Reference was also made to useful practical results which attended investigations on the transmission of detonations to considerable distances. The paper concluded with a review of the beneficial results in connection with the manfacture, transport, storage, and use of explosive agents, which had attended the judicious application of the measures included in the Explosives Act of 1875; and with comments, on the one hand, on the necessity for increased activity on the part of local authorities in some directions, in connection with the Act, and, on the other hand, on the danger to the public and to commercial interests, resulting from the persistent refusal of railway authorities to facilitate the legitimate transport of explosives.

CORRESPONDENCE.

PATENTS IN THE UNITED STATES.

A change in the United States Patent-office practice is just announced. It makes a model much less necessary than heretofore. It is probable that in practice models in all ordinary cases will be dispensed with. The law authorises the Commissioner of Patents to issue patents without models, but he has heretofore deemed it wise to require one in every case. The present Commissioner, General Paine, has long contemplated a change. Such is now announced:—

. . . "Applications complete in all other respects will be sent to the examining divisions, whether models are or are not furnished. . . . When a model shall be required, the examination shall be suspended until it shall be filed." W. Lloyd Wise.

7, Whitehall-place, London, S.W.

BALMAIN'S LUMINOUS PAINT AND PHOSPHORESCENCE.

At a time when the phenomena of phosphorescence is being brought before the public in a practical and useful form, the following historical note concerning it will not be without interest to the members of the Society of Arts, before whom a very interesting paper was read upon the subject on the 11th ult., more especially as it comes from a country which, during the last few years, has attracted attention from her rapid strides in the progress of the practical arts, and the adoption of the customs of modern western civilisation.

In the Transactions of the Asiatic Society of Japan, vol. iv., page 30, in the course of a paper read on the 20th October, 1875, entitled "On Some Copper Bells," by Kanda Takahira, Governor of Hiogo Ken, the following passage occurs:—"The first instance of the discovery of a copper bell is of exceedingly old date. A short time ago I visited a friend of mine, Mr. Yokoyama Yoshikiyo, a widely-read and well-informed antiquarian, and questioned him upon the subject, when I received from him a written reply that is of great importance. This I give below. In vol. v., of the 'Fusô-ruyak'ki,' it is stated that on the 17th day of the first month of the seventh year of the Emperor Senji's reign, corresponding to the year 669 A.D. of the foreign calendar, when the temple of So-fuku-ji

was being erected in the Department of Shiga and province of Omi, and the earth was being preparatorily levelled, a strange and valuable bell was dug up from the ground. Its height was five feet five inches. There was also dug up a wonderful kind of white stone, five inches in length, which shone brightly at night." This last remark is significant, and there can be little doubt that the phenomena referred to can be none other than a case of phosphorescence, and the stone was, doubtless, one of those natural posphorescent bodies which of late have received such an amount of attention.

Edmund F. Mondy.

36, Casella-road, New-cross, S.E.
April 6th, 1880.

A RAILWAY ROUTE TO INDIA.

There is, doubtless, a great deal to be said in favour of Mr. Haughton's project, but I think that the magnitude of it will do very much to prevent its being undertaken, at all events, as an entirety.

The pressing need exists, as well shown by General Cotton, of a route to India, alternative to the Suez Canal, but quicker; and if such is to be completed in a short space of time, the only practicable method appears to be by the aid of a railway through Mesopotamia, regarding which, Mr. W. P. Andrew so ably dwelt upon previously. With the exception of that comparatively short communication, the whole of the alternative route to India, may be said to be at the present moment, in some kind of working order. Already there are various lines of steamers from some English and Continental ports trading constantly to different Syrian ports; and the British India Steam Navigation Company have for years past had a regular service in the Persian Gulf. It is well known in shipping circles that, in these times, steam companies are only too glad to be enabled to avail themselves of granting through passages and freights as soon as they find that communications between various points have been established.

The Ismid Railway now constructing, as alluded to by Mr. Rumball, if eventually continued to a Mesopotamian line, would be a highly important addition, and might, indeed, at a still later period, prove to be a link in the chain of a through railway to India, if such be ultimately completed through either Northern or Southern Persia.

Frank Tayler, F.R.G.S.

156, Leadenhall-street, E.C.,
5th April, 1880.

GENERAL NOTES.

Edinburgh School of Cookery and Domestic Economy.—The fourth annual report of the Executive Committee of this school has been published, from which it appears that the commercial depression, consequent on the failure of the City of Glasgow Bank, seriously affected the classes at the central school, and also the branch classes in other towns. While, however, this depression caused anxiety, and rendered the treasurer's balance-sheet less favourable than it would otherwise have been, subsequent experience showed that the reduced attendance at the Edinburgh classes was only temporary, as the average attendance was subsequently reached. In consequence of the demand for instruction in the various domestic subjects, it was decided to add gradually to the school teaching such subjects as are likely to prove useful in domestic life. In consequence, the words "Domestic Economy" are added to the name of the institution. The following classes and courses of lectures are arranged for the present session:—Cookery (demonstration and practice); cutting-out dresses and underclothing; sewing, darning, and mending; ironing and clear-starching; doing up fine lace; courses of lectures on the theory of food; on domestic economy; on sick nursing, and on what to do in emergencies.

New Kinds of Tea.—In a report which he has addressed to the Department of Finance and Commerce at Calcutta, Mr. E. Colborne Baber, lately H.M.'s Consular representative at Chungking, states that during his travels in the mountainous region west of Kiating-fu, in Szechuen (Western China), Mr. Baber discovered two kinds of tea of a very unexpected nature. In the monasteries on Mount Omi (or Ngomi) he was given an infusion of tea which is naturally sweet, tasting like coarse congou with a plentiful addition of brown sugar. It is only grown by the monks on the slopes of the mountain, and two days' further west its existence was unknown. The other variety, odd as it may appear, has a natural flavour of milk, or perhaps more exactly of butter. It is wild tea, growing in its native elevated *habitat* without cultivation; and an unimpeachable instance of a wild tea-plant has, Mr. Baber affirms, never yet been adduced in China. This wild tea is found in the uninhabited wilderness west of Kiating and south of Yachow, at heights of 6,000 feet and upwards, and was described to Mr Baber as a leafy shrub 15 feet high, with a stem some four inches thick. Every part of the plant, except the root, is used for making the infusion; the wood is chopped up and put into a kettle of water with the dried leaves and twigs, and being boiled yields a strongly coloured but weak tea, possessing a buttery flavour, which gives it some resemblance to the Thibetan preparation. Mr. Baber only found it in the Hwang-mu-chang plateau, a terrace perched among the stupendous gorges of the Tung river.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

April 14. — "The History and Art of Bookbinding." By Henry B. Wheatley, F.S.A., Assistant Secretary of the Society. George Bullen, F.S.A., Keeper of the Printed Books, British Museum, will preside.

April 21.—"The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt. Sir Coutts Lindsay, Bart., will preside.

April 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By Thomas Fletcher.

May 5.—"The last Forty Years of Agricultural Experience." By John C. Morton. James Caird, C.B., F.R.S., will preside.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry. Sir T. Douglas Forsyth, K.C.S.I., C.B., will preside.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Terrien de La Couperie. Professor Robert K. Douglas will preside.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

April 27.—"Iceland and its Resources." By C. G. W. Lock.

May 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

April 22.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S.

[Note.—It is probable that some alterations will need to be made in these dates.]

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course will be by R. W. Edis, F.S.A., on "Art Decoration and Furniture," and will consist of six lectures.

Lecture II.—April 12.

Floor, Wall, and Ceiling Decoration.—Mosaics. Tiles. Parquetry. External painting. Tapestry and stuff hangings. Wall papers. Various types of wall and ceiling decoration. Distemper. Stencil work. Figure decoration.

Lecture III.—April 19.

Furniture.—Ancient and modern. General. Constructive furniture: mantel-pieces, fireplaces, fenders, closets, lavatories, window-seats.

Lecture IV.—April 26.

The Entrance-hall, Stairease, Dining-room, and Library.—General treatment. Division of wall spaces. Examples of treatment. Decoration and furnishing.

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and One friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

Erratum.—Page 402, col. 1, No. 3, line 7 from end, for "½ F 135·2," read "½ F 1352."

MEETINGS FOR THE ENSUING WEEK.

Monday, April 12th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture II.)
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. C. G. Saunders, "Quantity Practice."
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m.
Medical, 11, Chandos-street, W., 8½ p.m.

Tuesday, April 13th...Metropolitan Scientific Association, 13, Blomfield-street, E.C., 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Huxley, "Dogs, and the Problems connected with them." (Lecture II.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "Explosive Agents," and, time permitting, 1. Mr. C. F. Gower, "Abingdon Sewage." 2. Mr. G. Chatterton, "Main Drainage of Torquay."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Rev. Lorimer Fison, "Notes on Fijian Burial Customs." 2. Mr. C. Staniland Wake, "Notes on the Polynesian Race."

Wednesday, April 14th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. Mr. Henry B. Wheatley, "The History and Art of Bookbinding."
Geological, Burlington-house, W., 8 p.m. 1. Prof. W. Boyd Dawkins, "The Classification of the Tertiary Period by means of the Mammalia." 2. Mr. W. H. Twelvetrees, "A New Theriodont Reptile (*Cleiorhizodon orenburgensis*, Twelvetr.) from the Upper Permian Cupriferous Sandstones of Kargalinsk, near Orenburg, in South-Eastern Russia." 3. Mr. A. H. Stokes, "Faröe Islands: Notes upon the Coal found at Suderöe."
Graphic, University College, W.C., 8 p.m.
Microscopical, King's College, W.C., 8 p.m. 1. Dr. M. C. Cooke, "The Genus Ravenelia." 2. Mr. G. Hoggan and Dr. F. E. Hoggan, "The Development and Retrogression of Blood-vessels." 3. Mr. A. Grunow, "Some new Species of Nitzschia." 4. Mr. W. Webb, "A New Finder."
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
Telegraph Engineers, 22, Great George-street, Westminster, S.W., 8 p.m. 1. Professor D. E. Hughes, "Note on some Effects Produced by the Immersion of Iron and Steel Wires in Acidulated Water." 2. Mr. W. Chandler Roberts, "Note on Professor Hughes' Communication." 3. Mr. Augustus Stroh, "The Adhesion of Metals Produced by Currents of Electricity."

Thursday, April 15th...Royal, Burlington-house, W., 8½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. N. E. Brown, "Some New Aroideæ; with Observations on other known Forms." 2. Rev. R. Boag Watson, "Mollusca of H.M.S. *Challenger* Expedition." (Part V.) 3. Dr. J. Murie, "Some Malformed Pearls."
Chemical, Burlington-house, W., 8 p.m. 1. Dr. Mills, "The Lecture Illustration of Chemical Curves." 2. Mr. W. H. Perkin, "The Analysis of Organic Bodies containing Nitrogen" (continued).
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture II.)
Royal Historical, 22, Albemarle-street, W., 8 p.m. 1. Mr. C. Pfoundes, "Notes on the History of Japan." 2. Mr. Fairless Barber, "The Principles on which Historical and Antiquarian Researches should be Conducted, and the Associations of Historians and Antiquaries Regulated." 3. Rev. W. S. Lach-Szyrma, "Historical Memories of Cracow."
Numismatic, 4, St. Martin's-place, W., 7 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Friday, April 16th...**SOCIETY OF ARTS** John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Prof. Vambéry, "Russia's Influence Over the Inhabitants of Central Asia During the Last Ten Years."
Royal United Service Institution, Whitehall-yard, 3 p.m. Major Wilkinson Shaw, "The Organisation and Tactics of Military Convoys in War."
Royal Institution, Albemarle-street, W., 9 p.m. Mr. Ernest Renan, "Marcus Aurelius."
Philological, University College, W.C., 8 p.m. Mr. Hy. Sweet, "History of English Sounds and Dialects, Part II."
Quekett Microscopical Club, University College, W.C. 8 p.m.

Saturday, April 17th...Royal Institution, Albemarle-street, W., 3 p.m. Mr. James Sully, "Art and Vision." (Lecture II.)

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, APRIL 16, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The second Lecture of the third course of Cantor Lectures on "Art Decoration and Furniture" was delivered by R. W. Edis, F.S.A., on Monday, the 12th inst., the subject being "Floor, Wall, and Ceiling Decoration." Drawings in illustration of the Lecture were exhibited by H. Stacey Marks, R.A., and wall-papers, parquetry, and Co., J. G. Crace and Son, Howard, Jeffreys, &c., by the following firms:—Messrs. Arrowsmith Morris and Co., Scott and Cuthbertson, and Walton. The Lectures will be published in the *Journal* during the autumn recess.

WATER SUPPLY OF LONDON.

To the Secretary of the Society of Arts.

Sir,—I beg leave to call the attention of the Council to the following passage, which concludes an article in the *Times*, of the 14th April:—

"The first necessity is that London at large should have the best supply of water that the country can afford. We have, therefore, first to determine how this necessity can best be met, and until that preliminary question, which has hardly been discussed as yet, is fully sifted and solved, it is premature to consider whether it is worth while to purchase the property of the existing companies, and still more to attempt an estimate of the intrinsic value of their undertakings."

I suggest to the Council to organise a Conference to discuss this question, at an early period. Regard should be had to the proceedings of the Conference on National Water Supply, in May, 1878, which took place at the suggestion of H.R.H. the Prince of Wales, the President, whose letter may well be reprinted on this occasion.

I venture to repeat what I said at that Conference, that "England might be divided into a heptarchy, having six, seven, or eight great sources of water supply." One of these might provide a constant supply of pure softened spring water for the metropolis, it is thought, for less money than the purchase of the water companies with their suspicious water in some instances.—I am, Sir, &c., Henry Cole.

The following is the letter of H.R.H. the President of the Society, referred to by Sir Henry Cole:—

Clarence-house, St. James's, S.W.,
30th January, 1878.

Sir,—The supply of pure water to the population is at the present time exciting deep interest throughout the country. Our great cities and populous towns, such as Manchester, Liverpool, Birmingham, and others, are, each for itself, taking steps to obtain an improved and increased supply, whilst the metropolis is seeking further powers from the Legislature with the same object in view. The smaller towns and villages are dependent on accidental sources of supply, and in many instances these are wholly inadequate for health and comfort. While the larger populations are striving, each independently and at enormous cost, to secure for themselves this article of prime necessity, the smaller localities must make the best shift they can, and in many instances are all but without any supply at all.

Under these circumstances, I would draw the attention of the Council to the subject, and suggest whether, at the present time, great public good would not arise from an open discussion of the question in the Society's rooms, with a view to the consideration of how far the great natural resources of the kingdom might, by some large and comprehensive scheme of a national character, adapted to the varying specialities and wants of districts, be turned to account, for the benefit, not merely of a few large centres of population, but for the advantage of the general body of the nation at large.

I have the honour to be, Sir,
Yours faithfully,
(Signed) Albert Edward P.,
President of the Society of Arts.

To the Chairman of the Council of the Society of Arts.

COMMITTEE ON POISONOUS COLOURS.

The Council having had their attention directed to numerous cases of reputed poisoning by arsenical wall-papers and other articles in general household use, have appointed a Committee to inquire into the practicability of preventing the employment of arsenic in any processes by which it is allowed to remain in finished goods, and to obtain evidence as to the effect a total prohibition of the use of such processes, or the prohibition of the sale of articles produced thereby, would have upon various trades.

To promote the object in view, a form containing questions as follows has been issued by the Committee:—

1. In what colours, dyes, mordants, or other preparations used in trades or manufactures in this country, is any preparation of arsenic employed?
2. For what other purposes and processes is arsenic employed?
3. Do you attach any special importance to the continued use of any arsenical colours for preparations, such as leave arsenic in the finished goods? and, if so, what preparations, and for what reasons?
4. Would it be any disadvantage to you if the use of such colours, dyes, pigments, or other arsenical preparations, both of home and foreign manufacture, were prohibited? and, if so, what disadvantage?

The Secretary will be glad to receive answers to the above questions from persons interested in the

subjects, on or before the 30th April. Such answers should be accompanied by any further statement or remarks which may be deemed advisable to lay before the Committee.

SECTION OF APPLIED CHEMISTRY AND PHYSICS.

Thursday, April 8th, 1880; Professor Charles Graham, D.Sc., F.C.S., in the chair.

The paper read was on—

THE NEWER ARTIFICIAL COLOURING MATTERS DERIVED FROM BENZENE.

By R. J. Friswell, F.C.S., F.I.C.

Methyl Aniline Violets.—It is, no doubt, well known to many here that the earliest violets obtained by artificial means were those produced by the action of pure aniline, or phenylamine, on roseine, in the presence of an organic acid. A study of this reaction by Hofmann led to his discovery of the action of the iodides of the alcoholic radicles, methyl and ethyl, on roseine base, with the production of the well-known "Hofmann Violets." These were found to be substitution-products of rosaniline, in which one, two, or three atoms of hydrogen in the molecule are replaced by the radicles methyl or ethyl, according as the iodide of either has been used.

Now roseine itself is, as is well known, produced by the action of arsenic acid or other oxidising agents on a mixture of aniline and toluidine. The chemical formula then adopted for it led to the conclusion that it was produced by the coalescence of the residues of two molecules of toluidine and one of aniline, thus :—

$$C_6H_5NH_2 + 2C_6H_4CH_3NH_2 - H_6 = C_{20}H_{19}N_3$$

O. and E. Fischer have recently shown that this formula was partly erroneous, and that the reaction could also occur between two molecules of aniline and one of paratoluidine—

$$2(C_6H_5NH_2) + C_6H_4CH_3NH_2 - H_6 = C_{19}H_{17}N_3;$$

but this does not affect the inference drawn from what was, till recently, supposed to be the constitutional formula of the body in question, and this inference was that the methylated derivatives of roseine could be obtained by the oxidation of the methylated derivatives of aniline, just as roseine was by the oxidation of aniline and toluidine. The inference was somewhat rash; the methyl groups in dimethylaniline replace the hydrogens in the amido group, and on oxidation might, perhaps, be destroyed. However, on oxidation, dimethylaniline did, indeed, produce a very brilliant violet colour, which, having been discovered by M. Lauth, and improved and patented by Messrs. Poirrier and Chappat, was introduced into commerce under the name of Paris Violet. This achievement led to a demand for the production of the methyl anilines on a large scale, and, in a very short time, this was attained. It was well known that methylaniline could be produced by the action of methyl iodide, or bromide, upon aniline, the dimethyl compound resulting from the use of two molecules of the alcoholic compound; thus

$$C_6H_5NH_2 + 2(CH_3I) = C_6H_5N(CH_3)_2 + 2HI;$$

but it was evidently necessary to produce the required compound in a cheaper way. This was eventually done by heating aniline hydrochloride and methylic alcohol together, under pressure, in strong cast-iron vessels, enamelled inside, and known as "autoclaves." Various proportions of the bodies have been employed—among others, the following giving good results:—Aniline, 33·6; hydrochloric acid, 37·9; methylic alcohol pure, 28·5; heat to 250° C. for eight hours. Messrs. Poirrier have also employed a mixture of 100 parts aniline and 250 methyl nitrate. In the latter case, the mixture requires only a temperature of 100° C.; but the alcoholic nitrate is an exceedingly dangerous compound to deal with; in all probability, it was the one that led to the lamented death of Mr. E. T. Chapman, and a very disastrous and fatal explosion at Messrs. Poirrier's works was also caused by it.

Methylaniline is now largely made by the action of methyl chloride on aniline. As is well known, the former body has, of late years, been obtained in immense quantities in France, from a product of the destructive distillation of residues obtained in the manufacture of beet sugar. This body reacts upon aniline just as the corresponding iodide or bromide does; it is cheap, the reaction takes place with ease, and a remarkably pure product is produced: in fact, dimethylaniline can now be obtained by the ton, free from unaltered aniline, and containing only 3 per cent. of the monomethylated compound.

From dimethylaniline the violet is obtained by oxidation; formerly, various oxidising agents were used, among them a mixture of iodine and potassium chlorate; it is, however, now well known that very gentle oxidisers will produce the colour if a metallic salt is present, the one preferred being copper. If I heat, in this tube, some copper filings with a mixture of dimethylaniline and chloral hydrate, the whole will shortly become a mass of semi-solid violet. It is, however, obvious that so costly a method could not be employed on a manufacturing scale, and, accordingly, the following process is in very general use:—Twenty parts pure crystallised cupric nitrate are dissolved in 20 parts of acetic acid; some common salt is now stirred in to the mixture, which is carefully cooled down to the ordinary temperature, and 50 parts of dimethylaniline are added; the whole is then thoroughly mixed with about 250 to 300 parts of white sand, and the stiff mass thus produced is moulded into large cakes, 2 feet long by 15 inches wide, and 4 inches thick; these, arranged on copper plates, are placed in a chamber, and heated to a temperature of 60° C. for 48 hours. At the end of that time, they have become perfectly hard and brittle, and of a bright brassy colour. They are broken into a coarse powder and thrown into water, sulphide of sodium being added until the whole of the copper-salt has been decomposed. The mass is now washed with water and extracted with dilute hydrochloric acid at a boiling temperature. After partial cooling and filtration, to remove some resinous bye-products, the colouring matter is precipitated with common salt, and, after drying, it is ready for use. The sand, which

simply serves to spread the mixture over a large surface, can be used for a fresh operation.

The product thus obtained is very brilliant in colour, and in shade is that known as 3 B, dahlia, &c.; it is, however, not the bluest that can be produced. The bluest shades are made by dissolving it in alcohol, converting it into base by the cautious addition of caustic soda, and then heating the alcoholic solution of the base with benzyl chloride—a body having the formula $C_6 H_5 CH_2 Cl$, and produced by the action of chlorine on toluene. The spirit and unaltered benzyl chloride are recovered, and the basic colour, on conversion into the hydrochloride, is ready for use. In a similar way, by the action of methyl chloride, the well-known methyl green was produced; it is now, however, replaced by the malachite green, discovered by Oscar Doebner, and produced by the action of one molecule of benzoyl trichloride, $C_6 H_5 C Cl_3$, on two molecules of dimethylaniline or of benzoylhydride, or bitter almond oil, $C_6 H_5 COH$, on the same in the presence of zinc chloride or of sulphuric acid.

The latter colour much supasses the former in fastness and power of standing rough treatment in the dyeing process. The methyl, and, still more, the iodine green obtained during the manufacture of blue shades of Hofmann violet, were fugitive and easily altered by heat, so that the latter could could not be boiled without changing to a violet.

Before leaving the methylaniline colours, I may briefly allude to a question of scientific interest in connection with them. It is well known that Hofmann himself, at one time, considered the violets obtained by the methylation of rosaniline and those from methylaniline to be identical. On the other hand, there was much evidence against this view, for the methylaniline colour was readily rendered bluer in shade by benzyl chloride, which was almost without action on the Hofmann one; it was also more brilliant, had a much greater affinity for animal fabrics, and was less permanent when exposed to light. For these reasons, the Hofmann colour is still in demand, and, indeed, has recovered some of the ground it at first lost to the more brilliant colour. The researches of Brunner and Brandenburg, following those of Caro and Graebe, have shown that the methylaniline violets are not identical with those obtained by Hofmann's process.

Diphenylamine Blue and Alkali Green. — The ordinary aniline blues are obtained by the action of aniline upon roseine base, in the presence of an organic acid, at a temperature which ultimately approaches the boiling point of the aniline used. The ultimate product of this reaction is an exceedingly intense blue, the hydrochloride of which is known as opal blue, and is, really, the hydrochloride of triphenylrosaniline. This, on dry distillation, yields diphenylamine, and the latter body, on oxidation, yields a blue which is identical with that obtained from rosaniline, but somewhat greener in shade, and is therefore in demand for certain uses. The diphenylamine is prepared by heating, under pressure, a mixture of aniline and dry aniline hydrochloride, when the following reaction occurs:—

$$C_6 H_5 NH_2 + C_6 H_5 NH_2 \cdot HCl = (C_6 H_5)_2 NH + NH_4 Cl.$$

Diphenylamine is readily oxidised if heated with oxalic acid, and the resulting melt, purified from unaltered oxalic acid, diphenylamine and resinous matters, is readily converted into either of the sulphonic compounds discovered by Nicholson. Blues of a redder shade can be also obtained by the oxidation of methyl- or ethyldiphenylamine.

I have now to call your attention to a green obtained from this body, discovered by Mr. R. Meldola, and now under his investigation. It is obtained by the oxidation of a diphenylamine derivative. After oxidation the colour is obtained in a state corresponding to the well-known opal-blue, and, like that, forms sulphonic acids. It is remarkable as being the first green obtained having this property. The sodium salt of the sulphonic acid is soluble in water, and, if wool is immersed in this solution (which is nearly colourless), and kept warm, it apparently undergoes but slight change. I have here a piece of Berlin wool which has been thus treated, and subsequently dried. You will observe that it is, apparently, only rather dirtier than undyed wool. When, however, I immerse it in warm water, acidulated with sulphuric acid, a brilliant green is immediately developed. The colour is remarkably fast; and, since it requires exactly the same dyeing process as do the Nicholson blues for wool, one would have supposed that it would have been much liked by the dyers; but this is not, at present, the case. It was exhibited at the late Paris Exhibition by the firm of Brooke, Simpson, and Spiller.

As time is getting on, I must now leave this very interesting field — the colours produced by the oxidation of the secondary and tertiary amines—after a very brief and incomplete glance at a few of them, and pass on to the consideration of a totally distinct group of colouring matters, which are now attracting much attention in colour-chemists' laboratories, and which have already taken an important place among artificial dyes, though, as yet, the range of shades is somewhat limited. These are obtained from substances produced by the action of nitrites on amido compounds, and are known as the azo-yellows, oranges, and scarlets.

The effect of nitrites on organic compounds is very various, according to the subsequent treatment they undergo; thus, if nitrous gas is passed through a solution of diphenylamine in acetic acid, a mixture of nitroso-nitro-diphenylamines results, and this, on heating with an alkali, decomposes so far as the nitroso groups are concerned, and a mixture of mono and dinitro diphenylamine results, which was introduced as a yellow dye by Mr. R. Meldola. A somewhat similar reaction occurs if the sulphonic acid of alpha naphthol is similarly treated, and dinitronaphthol may be obtained; while, if a nitrite is added to an aniline salt, and the resulting compound boiled, or if rosaniline salts are similarly treated, the whole of the nitrogen is eliminated with effervescence, and phenol in the one case, rosalic acid in the other—both of them non-nitrogenous substances—result. Before this boiling takes place, there are, however, in the two latter cases, very different bodies in solution; these bodies, which behave in the manner just mentioned on boiling, are known to chemists as "azo compounds."

In the earlier days of organic chemistry, the prefix "azo" was applied by Mitscherlich, Laurent, Zinin, and others to many bodies containing nitrogen, such as azo-benzene, $C_6H_5N=NC_6H_5$, produced by the imperfect reduction of nitro-benzene, and also to others, like the compounds obtained by Laurent by the action of ammonia on bitter-almond oil and other bodies. In 1864, however, P. Griess published a magnificent memoir, in which he described a number of bodies obtained by the action of nitrous acid on aniline, and various substitution-products obtained therefrom. In this paper, he proposed that the prefix "azo" should be held to mean that the compound to which it was applied contained one atom of nitrogen occupying the place of one atom of hydrogen. This definition is now generally accepted, and thus the term "azo" has obtained a definite signification.

The azo compounds are, as a rule, very easily prepared; in most cases, it is only necessary to add a solution of metallic nitrite to an acid solution of a given amide, in order to obtain the diazo compound of the radicle contained in the amide; thus, if I take a solution of aniline hydrochloride, and add to it an equivalent quantity of sodium nitrite solution, the reaction at once takes place, and diazobenzene is produced; it can be readily separated from its solution, and obtained in the solid state, one method being to add a solution of potassium dichromate when the chlorochromate of diazobenzene is produced. This salt, when dry, is terribly explosive, and at one time was suggested for use in warlike operations; however, it very rapidly decomposes when kept, losing nitrogen, and becoming no longer efficient.

This explosiveness is readily understood when we consider the constitution of the body which contains the group—N=N—. It is manifestly in a state of unstable equilibrium, and a very slight disturbance is sufficient to bring about its decomposition; and, for the same reason, you will at once see that its chemical activity, as measured by its tendency to combine with other bodies, will be great; so that, if I add to it another molecule of aniline salt, or, what amounts to the same thing, if I add to two molecules of aniline only one of sodium nitrite, the diazobenzene formed at once attacks the free aniline salt, and what is known as diazoamidobenzene is formed, which, in the presence of an aniline salt, becomes amidoazobenzene—$C_6H_5N=NC_6H_4NH_2$. The oxalate of this body was once in pretty general use as a yellow dye, but, as it happened to be volatile at a very low temperature, it soon evaporated from the dyed article, and was, therefore, discarded.

A compound having a very similar constitution and mode of preparation has, however, long been in use, and is one of the most permanent of the aniline colours, under the name of "Bismarck Brown." It is obtained as follows:—

Metadinitrobenzene is prepared by boiling ordinary nitrobenzene with nitric acid. The compound thus produced is added cautiously, with constant agitation, to coarse iron borings, kept boiling in a large quantity of water acidulated with hydrocloric acid. A violent reaction soon commences (I could readily show you the experiment, but for the steam and unpleasant odour produced); the four oxygen atoms contained in the dinitrobenzene are replaced by hydrogen, thus:—

$$4\,C_6H_4(NO_2)_2 + Fe_{15} + 4OH_2 = 4\,C_6H_4(NH_2)_2 + 5\,(Fe_3O_4).$$

We have thus produced diamidobenzene, and this, when purified from a little dissolved iron, is attacked with sodium nitrite solution; the reaction here is analagous to the one last described, the final product of the reaction being a triamido-azobenzene, the hydrochloride of which constitutes the well-known colouring matter. We have thus two terms of a possible series—first, the amido-azobenzene (yellow, volatile, and fugitive), and triamido-azobenzene (brown, and perfectly fast). Dr. Witt set himself the task of filling up the intermediate link, expecting an orange colour, and a moderate stability for the diamido-azobenzene he sought. In this he was not disappointed. A study of the two compounds, from a purely scientific point of view, led him to a perfectly accurate prediction; and the discovery of "chrysoidine," as the new colour was called, and its production—by the addition of diazobenzene chloride to a solution of diamidobenzene—was one of the first of a series of researches which have, in various hands, enriched our science and our dyers with a number of magnificent colours.

The further development of these colours commenced with the introduction of a sulphonic group into one of the amido compounds, the conversion of the sulphonic acid thus produced into a diazo body, and then using it as before; for instance, if sulphanilic acid—produced by the action of strong sulphuric acid on aniline—is converted into diazosulphanilic acid, and this added to a solution of diamidobenzene-hydrochloride, the scarlet body produced is the sulphonic acid of chrysoidine. Again, the same body will act on resorcine to produce a colour only differing from the last in that it contains hydroxyl instead of amido groups; this body has been used as a dye, under the name of Tropæoline 0. Witt also produced, by substituting diphenylamine for the resorcine, or diamidobenzene, another beautiful orange, known in commerce as Tropæoline 00. Other compounds were subsequently prepared, and have obtained greater prominence; these were those in which a naphthol was substituted for the phenolic or amido portion of the molecule, beautiful oranges being produced by the action of diazobenzene sulphonic acid on both α and β naphthol; but these colours were much improved by the introduction of sulphonic groups into both portions of the molecule, α or β naphthol-sulphonic acid being, in fact, substituted for the naphthol only; still, so far, the improvement was in the direction of stability mainly, the shades still being yellow or orange; the red was yet to come.

Chemists will not be surprised to hear that the higher homologues of benzene are found, when converted into amido compounds, to give an increased redness of shade; thus, with a given phenol or amine, diazosulphotoluidinic acid, which differs from diazosulphanilic acid by having an atom of hydrogen in the benzene ring replaced by methyl, gives redder shades than does the latter, while the substitution of another hydrogen in the same way, as is the case with the diazo compound derived from sulphoxylidenic acid, produces a scarlet. Messrs. Meister, Lucius, and Bruning were among the first to produce a scarlet by this method, but they also introduced both the sulpho groups into

one side of the molecule—that of the napthol. In their patent they describe the preparation of two isomeric β napthol-disulphonic acids, the sodium salts of which are differently soluble in alcohol, the most insoluble one giving a redder colour than the other. On one or other of these they act with diazoxylene chloride, produced by the action of a nitrite on xylidine chloride. The most insoluble salt above mentioned gives a scarlet closely approaching cochineal, and perfectly fast.

Mr. R. Meldola has also taken out a patent for a scarlet, in which no less than three sulpho groups are engaged. He prepares diazosulphoxylidenic acid, and with this acts on β naphthol disulphonic acid; on the addition of ammonia, the colour is immediately thrown down, as you perceive. This is, after a slight purification, ready for use. By certain modifications, a scarlet, closely approaching the scarlet obtained by dyeing cochineal in the presence of oxichloride of, tin is produced.

So far, we have only oranges and scarlets by these reactions. Whether other colours can be similarly produced remains to be seen; but I may mention that Mr. Meldola has recently communicated a paper to the Berlin Chemical Society, in which he describes a violet colour—unfortunately not a dye -- obtained in a somewhat similar way. If we act on dimethylaniline—the body from which the violets described in the first part of my lecture are derived—with a nitrite; not an azo, but a nitroso dimethylaniline, is produced thus:— $C_6 H_4 NO N (CH_3)_2$. This body is as ready to combine with others as an azo body is, and does so in a very similar way, the oxygen atom being eliminated in the process, so that if we act with it on β napthol the following combination takes place*:—

$$C_6 H_4 . N . N (CH_3)_2$$
$$\|$$
$$\beta C_{10} H_5 HO$$

The oxygen of the nitroso group going off with two hydrogens from the β naphthol, the place of which is taken by a group, which is equivalent to azo-dimethylaniline. The colour crystallises magnificently, but its dyeing powers are very feeble.

I must now conclude a very imperfect sketch of some of the recent advances of colour chemistry. If I have succeeded in showing some that practical results do come from purely scientific researches, I am content. Hard things are often said of the aniline dyes; they are looked on as poisonous and fleeting. The first accusation is untrue, properly used they are perfectly harmless. The second is only true of some few of the series, and many of the older dyes are equally evanescent, while none are so beautiful and brilliant—though this may be considered a fault, for some highly æsthetic persons look on the producer of brilliant colours almost as a criminal.

The colour-chemist may contemplate all these hard sayings with an even mind. In the humble position of a scavenger, he takes some of the most noxious waste products of our civilisation, those produced in the gas manufacture, and converts them into useful and beautiful colouring matters. If these are improperly applied to the cloth or fabric that is not his fault; while if they are inartistically used our æsthetic friends have the remedy in their own hands.

* This formula is given under reserve, as a complete investigation of the compound has not yet been published.

DISCUSSION.

Mr. Spiller was much pleased to be able to express his obligation to the reader of the paper for what he considered to be a very good account of the latest outcome of the benzene colour industry. It would be manifest to the audience, although they might not in every particular have been able to follow the theory of the matter, or understand all the hard names, that this benzene dye industry had, of late years, made gigantic strides. From his own connection with this class of work for ten or twelve years, he was able positively to say that the number of new colouring matters gained within that period was considerable, and he would put it on a more forcible basis than even Mr. Friswell had done, and say that, at the time when he first occupied himself with this work, it was the rule to select out the benzole of the coal-tar and naphtha, and throw away a large residual product which was then known as dead-oil. As its name implied, dead-oil would manifestly be a waste product thrown away, or used for confessedly inferior purposes. But the requirements of the latest forms of colouring matter, those which had just been mentioned, particularly the orange and scarlet, demanded that a certain quantity of the dead-oil should be worked with a view to extract from it these materials which were formerly worthless. For instance, it was necessary to save toluene, and also to save for the purposes of manufacturing the new scarlets, the xylene. These were now economised. And they were also making considerable strides towards working up naphthaline. Now, naphthaline had, for a great number of years, been a perfect bugbear in scientific industry. It was produced in immense quantities in the manufacture of gas, and whilst anthracene had been, by the labours of Perkin and Grabe, admirably employed in the manufacture of artificial colouring matters, which were substitutes for madder, naphthaline, the lower term in the series had been thrown away. But, however, they had a chance of using it in the production of the beautiful colours brought forward that evening, particularly the scarlet, one of the colours which had been so well described by Mr. Friswell.

Dr. Armstrong, F.R.S., said he did not know what right Mr. Friswell had to speak of coal tar as a noxious product. He thought they it was harmless when left alone, and Mr. Friswell had shown, when properly treated, it was capable of exhibiting itself in a very different light. The paper he had read ought to convey a very sound lesson to the objectors to abstract science, because they knew very well that, practically speaking, the whole of these colours were the result of investigations originally undertaken entirely without any practical aim. Chemists were led to investigate these various substances from pure love of their science, with the object of learning more about them, and, in the course of a very brief period, their discoveries had acquired an enormous practical value. He should not be far out, probably, in saying that, at the present time, with the exception of indigo, nine-tenths of the colouring matters used were artificial, produced from coal-tar, and that fact ought to be encouraging to holders of gas shares. There was a large amount of material still remaining in coal-tar not utilised, and there was, no doubt, a great future in that direction. These colours, which Mr. Friswell had spoken of in particular, afforded a striking illustration of the advantage of working on these subjects, and taking no heed whatever of the objections raised against chemists using long names and complicated formulæ. It was not more than ten or twelve years ago that it was found that alizarine and Turkey red could be produced artificially, and now practically all the Turkey red which was used was made artificially. A few years ago the substance used in the preparation of these colours were substance which even chemists were almost afraid to handle

Those so-called diazo compounds, originally discovered by Dr. Griess, were very difficult to manipulate, and extremely unstable; and even chemists would have laughed at the idea of using such unstable compounds for the preparation of colouring matters on a large scale. One feature was of particular interest, namely, that the great part of this work had been the outcome of theoretical views. The work of Dr. Witt, to which allusion had been made, was entirely such. He had formed certain ideas with regard to the theory of the constitution of colouring matters, that colouring matters ought to be bodies having certain constitutions, and he set himself to work to prepare bodies having certain constitutions, and realised his ideas, and still more chemists were rapidly getting a distinct notion of the theoretical constitution of colouring matters, so as to be able to say not only that a certain body would be a colouring body, but would have a certain shade.

Mr. Meldola said he cordially sympathised with the remarks which Dr. Armstrong had made, as to these valuable discoveries being the indirect outcome of researches, undertaken from a purely unpractical point of view; but, although Dr. Armstrong would lead many present to suppose that the science had arrived at that happy state when we could predict, to a certain extent, what colours would be produced by certain compounds, he must say that, speaking practically, they had not yet arrived at that happy position. In fact, it was owing to the great doubts which still surround many of the reactions, that new colouring matters had been produced. It was not possible to start from a given point of view, and say you would produce colours of a particular hue. There was no doubt that a great many of the products that now run down our drains would one day become quite as valuable as many of those which were employed in factories, and which gave rise to these colouring matters. The complex formulæ of diazo compounds having been referred to, must be his excuse for making a few more remarks on the same subject. Mr. Friswell had explained how diazobenzene chloride, for instance, acting upon another benzene nucleus containing in either an amido or phenolic group, the two benzene nuclei became linked together by the diazo group, giving rise to a complex molecule such as constituted the substance of these oranges and scarlets. The beginning of these substances was Dr. Witt's "chrysoidine;" by acting on metadiamidobenzene with the chloride or any other salt of diazobenzene, Dr. Witt produced $C_6 H_5 N_2$, $C_6 H_3 (NH_2)_2$, and you had two benzene nuclei grouped together by the diazo group. There had recently been another step made in this direction, and W. von Müller had described colours built up on this type, plus the addition of another benzene nucleus. Taking the ordinary aniline yellow, amidoazobenzene, he showed that two molecules of hydrogen could be taken out and replaced by nitrogen and another benzene nucleus thus attached, so that the formulæ of these diazo compounds were becoming more and more complex every day, and their number might go on increasing indefinitely. The whole subject illustrated very well the truth, that in the opinion of the chemist there was no matter which might not some day be turned to useful account; and very often the products which were at one time most despised suddenly became famous.

The Chairman said he had now a pleasing duty to perform of proposing a vote of thanks to Mr. Friswell, and he regretted it had not fallen to the lot of Mr. Perkin, who had gained a European renown in this form of chemistry; but, unfortunately, he had been unable to take the chair to-night, having a previous engagement. This was not a branch of chemistry with which he was sufficiently familiar to be able to take a very active part in the discussion, but, irrespective of the technical points of the paper, they had learnt much. They had heard very valuable observations made by Mr. Spiller, from a technical point of view, in which he referred to the fact, now clearly before them, that naphthalene, which had been for a long time not merely valueless, but a considerable nuisance to the gas engineer, was about to yield considerable results, which might be as brilliant as those yielded by anthracene; and they must all agree with Professor Armstrong that, after all, knowledge which was subsequently to become of value in technical operations, could only be built up, not by mere empiricism, but by scientific investigation. It would be perfectly impossible for any any one present to take those different bottles, and add the contents of one to the other, and expect to be able to obtain numbers of beautiful products; on the contrary, they might produce some very unpleasant results. These valuable and important bodies were not built up in that empirical way. They were the result of long previous scientific research; and when it was remembered that Faraday, before any of them were born, discovered benzene, and that long ago Undverdorben discovered aniline, it was evident that there must have been, from that time, a considerable amount of pure scientific research carried on before manufacturers were able at last to make use of these useful products of the coal distillation, and convert them into the valuable dyeing materials which we now possess. They had heard from the speakers that there was yet a very large and important field which had not been investigated; and inasmuch as the last fifty years, since the discovery of benzole, had produced such enormous results, more especially within the last twenty years, they might also assume that the next fifty years would utilise all, or almost all, of those numerous products which were now obtained from the destructive distillation of coal, and were at present considered useless. He had much pleasure in tendering to Mr. Friswell the hearty thanks of the meeting, for the very able and clear account he had given of the more recent work of this line of chemical activity. He had been very modest with regard to his own contributions to it, but they were indebted to him and to many others for the increase of knowledge in these matters.

The vote of thanks having been passed unanimously,

Mr. Friswell thanked the meeting for the kind way in which they had listened to what he feared must have been a tedious and somewhat inefficient explanation of a very difficult subject. He had also to thank his friend Mr. F. Evershed for the valuable assistance he had given in performing the experiments.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 14th, 1880; George Bullen, F.S.A., Keeper of the Printed Books, British Museum, in the chair.

The following candidates were proposed for election as members of the Society:—

Alexander, General Sir James, K.C.B., 35, Bedford-place, Russell-square, W.C.
Nottage, William G., Mawbyns, Breakspers-road, New-cross, S.E.
Strype, William George, Wicklow, Ireland.

The following candidates were balloted for and duly elected members of the Society:—

Andrews, J. D. F., 5, Mount-street, New Charlton, Kent.
Griffin, James T., Seaton-house, Adamson-road, N.W.
Horne, William Cullen, 31, Aldermanbury, E.C.
Ihlee, Henry Ferdinand, 31, Aldermanbury, E.C.

Japp, Alexander H., LL.D., 13, Albion-square, Dalston, E.
Penning, William Henry, F.G.S., Granville-house, Finsbury-park, N.
Shearer, Hugh, 21, Great George-street, S.W.

The paper read was—

THE HISTORY AND ART OF BOOK-BINDING.

By Henry B. Wheatley, F.S.A.
Assistant-Secretary of the Society.

I feel that it is a great privilege to be allowed an opportunity of treating some points in the history of Bookbinding from this place, and I think that the subject is one particularly appropriate for consideration before the Society of Arts, as the several aspects in which the art may be looked at are in unison with more than one of the objects of the Society.

Bookbinding may be considered as a Fine Art, as a Mechanical Art, and as a Manufacture, but, before dealing with these divisions of the subject, it will be well to take a rapid survey of the history of the art. It is not necessary to dive into the recesses of antiquity, and to bring to the surface the name of the ancient Phillatius—inventor of a particular kind of glue for fastening the leaves of a book together, to whom the Athenians are said to have erected a statue as the founder of the art of binding—for Bookbinding, as we now understand it, is essentially a modern art. So to deal largely with the numerous materials used at various times for the covering of books—such as terra-cotta, wood, ivory, metal-work, needlework, &c.—would carry us far away from the subject we have to consider.

The goldsmiths, the silversmiths, the enamellers, the ivory carvers, and many other artists not ordinarily associated in our minds with book production, all united to adorn the precious manuscripts of ancient times; so that St. Jerome was forced to exclaim, "Your books are covered with precious stones, and Christ died naked before the gate of his Temple." These adornments, however, helped to shorten the lives of the books they covered, as they often excited the cupidity of those into whose hands they fell. Thus, the Turkish soldiers, when they seized the magnificent library of Corvinus, King of Hungary, tore off the rich bindings and threw the manuscripts away as useless and valueless. Then, again, covers belonging to one book got separated from it, and were subsequently used as a protection to another of a different date. The late Mr. Libri made some remarks on this point, which are very pertinent, but were intended by him to account for certain 'botchings" of his own :—

"Not only are those bindings in metal, ornamented in different styles, and called Byzantine, very rarely of the same period as the manuscripts to which they may be found attached, but it is sufficient to cast an eye upon them to feel convinced that, to form them, objects belonging to different ages, due to various artists, and even executed in distant countries, have been employed. Indeed, we often meet with a singular mixture of cameos or ancient intaglios, Byzantine or Limoges enamels, and bas-reliefs of ivory or metal, belonging to totally different periods, and having widely different artistic characters. Sometimes, even ancient bindings, made originally for smaller volumes, have been used at a later date for books of a larger form, by affixing borders to some ornamental sides, placed as centres of the new cover. An example of this singular mode of *botching* is to be seen in an Evangelistarium taken from the *Sainte Chapelle*, and now preserved in the National Library at Paris."*

It is well to bear in mind that these books were intended to lie flat, and the upper cover, which was made heavy to keep the leaves down, was generally the only one ornamented. Naturally when books were made to stand up in bookcases, a different treatment became necessary.

Most of our kings have shown taste in the ornamentation of their books, and some of our queens have embroidered theirs with their own hands. The wardrobe accounts of Edward IV. contain some curious particulars respecting the covering of books. In 1480, Piers Bauduyn, stationer, was paid 20s. for binding, gilding, and dressing of "a booke called Titus Livius;" also the same sum for another book; and 16s. for a "booke called the Bible." For binding and dressing, without gilding, his charge for three books was 6s. 8d., and for dressing alone two books he received only 3s. 4d. These sums did not form the total expense of the binding, for velvet, silk, tassels, buttons, clasps, nails, &c., were delivered to the binder, for the purpose of covering and garnishing the books, out of the wardrobe stores. Alice Claver, silkwoman, was paid xivd. for an ounce of sewing silk, and sundry other sums for blue silk, black silk, laces, buttons, and tassels, and figured crimson satin. The coppersmith also received iiis. for each pair of clasps of copper and gilt with roses upon them, and vs. for each pair of clasps with the King's arms upon them.† These volumes, in their crimson and other gorgeous-coloured covers,

> "Full goodly bounde in pleasaunt coverture
> Of domas, satyn, or els of velvet pure,"

must have looked somewhat like those books which Hamlet and other stage heroes and heroines appear to read so intently, and then toss on to the floor, to the evident injury of their corners.

Although we may consider the invention of printing as our starting-point in the history of Leather Bookbinding, we shall find that velvet and embroidery was still frequently employed in binding the books of our Royal Family for a long period after leather had come into general use. Many specimens of velvet-covered volumes, embroidered with patterns in coloured silks and gold twist, have come down to our time. The presentation copy to Queen Elizabeth of Archbishop Parker's grand work, "De Antiquitate Ecclesiæ Britannicæ," 1572, is now in the British Museum. It is bound in green velvet, which is embroidered in high relief, with a representation of a park enclosed within pales, containing trees, shrubs, and deer, on the side. Even as late as Charles the First's reign, the Ferrar Family, at the so-called Protestant Nunnery of Little Gidding, gained great fame by their magnificent embroidered bindings. Prayer-books and other books of devotion were often bound in solid gold or silver, and hung from the girdle by a chain. One of these, which belonged to Queen Elizabeth, has been

* "Monuments Inédits ou peu connus, faisant partie du Cabinet de Guillaume Libri." Londres, 1862, p. 9.
† "Wardrobe Accounts of Edward IV.," 116-119.

frequently figured. All such bindings as these must be looked upon as curiosities of considerable interest, both in the history of Art and in the history of Books, but of little importance in the history of Bookbinding, for the binder, like the shoemaker, may well say there is nothing like leather. But, as the use of other materials than leather has continued to modern times,* so we find that leather was used for the less valuable manuscripts at a very early period, and stamped leather is peculiarly interesting, as exhibiting one of the earliest forms of engraving.† The Monks of Kenilworth were granted the right of hunting the deer, and the further permission of using the skins for their books, which reminds us of the well-known charter of Charlemagne to the abbots and monks of Sithen, by which they were granted an unlimited right of hunting, on condition that the skins of the deer they killed should be used in making gloves and girdles, and *covers for books*. The great French minister, Colbert, in later times, exhibited the same spirit as is shown in these charters, when, in a treaty between France and Morocco, he insisted on a stipulation that the latter State should supply a certain number of skins of leather, to be used for bindings in the Bibliothèque Royale.

Originally, the book-production of the world was in the hands of the printer, who was printer, binder, and publisher, all in one; thus Dibdin describes a copy of the "Mazarin Bible," which "exhibits the central and corner bosses upon the stamped-calf covered boards, into which it was originally placed, possibly under the superintendence of old Fust himself." The leather was, at first, stamped with a few ordinary straight lines, perpendicular or diagonal, and some simple ornaments; but gradually the patterns became more elaborate, and arabesque designs were introduced. Portraits and full length figures are frequently to be found stamped upon the old covers, and the German binders excelled in this branch of ornamentation. All this was in blind-tooling, for it was long before gilding became general, although it was in use in Italy before the end of the fifteenth century.

Germany.

Each country had its own special style, but I have only space at my disposal to allow of a mere allusion to some of these. Mr. Libri writes, in the preface to his catalogue, "Germany, where fine arts were so conspicuous at the same period, was sure not to neglect the art of binding. To the blind impressed sides of which I have already alluded, and which the Emperor Charles V. also generally adopted, shortly succeeded magnificently gilt and ornamented volumes, bound for the Emperor Maximilian, and for other princes of his family. The princes of the House of Bavaria were, we know, liberal patrons of bibliopegistic skill, and one of them, Duke Albert, was so fond of fine bindings, that we are told he formed in his own palace a sort of bibliopegistic academy, in which books were magnificently ornamented and gilt under his own inspection, assisted by designs furnished by able artists and the opinions of the learned. . . . During the sixteenth century, the ornamental art of binding penetrated everywhere throughout Europe, and not only in Flanders and in Spain, but even in the Sclavonic provinces and the East, skilful bookbinders had established themselves."

We are told that Cornelius, the bookbinder, was employed by Laurence Coster, at Haarlem, but names are not common, although, occasionally, some are to be seen on the old stamped leather covers. On an old German binding of the fifteenth century (Add. MS. 11,958) we read round the side this inscription, "Illi | ga | tus in Gys | lingen | per me | Rich | en | bach | Vulterius | pro mgro | Bartholomeo | Stolez de gmind;" and "Joris de Gaifere me ligavit in Gandavo omnes sancti angeli et archangeli Dei orate pro nobis," will be found on the cover of a volume in the Douce Collection (Bodleian Library, Oxford). Amongst some blind tooling of roses and eagles on an Augsburg binding of the fifteenth century, we read "Andres Jüger," and this inscription on some Flanders books of the sixteenth century is well known:—"Ludovicus Bloc ob laudem xpristi librum hunc recte ligavi." It is stamped on each panel; and a small book, with two panels on each side, has it, therefore, four times. A certain amount of good binding was produced in Spain, and Cardinal Ximenes, when he published his grand Complutensian Bible, at the beginning of the sixteenth century, is said to have given a special encouragement to a new style of binding, which harmonised with the grandeur of royal furniture and the carved enrichments of Gothic libraries.

Italy.

In the Manuscript Department (British Museum) is a fine specimen of Neapolitan work of the latter part of the fifteenth century (Add. 15,246). It is a large folio volume, bound in dark reddish leather, with a series of dots in blind tooling on the side, which forms a remarkable illustration of the rope-work pattern. It is, however, as the earliest European home of artistic binding with gold tooling that we must rank Italy; and one of the first of Italian collectors was Michael Maioli, who is supposed by Libri to have been a relative and predecessor of the more celebrated Thomas Maioli. "The taste for fine binding," writes Libri, in the preface to the Catalogue of the choicer portion of his library, 1859, "was spread through every class of Italian society, and, during the whole of the sixteenth century, we find books gorgeously bound for pious congregations, for religious men or women, for poets, for princes, for cardinals, and for popes; and we even see men celebrated for their humility, as well for their stern and modest habits of life, like St. Charles Borromeo and St. Pius V., admit as much refinement in the adornment of their books as the most dissolute and profligate of men, such

* Bishop Maltby, of Durham, caused a magnificent covering of silver gilt, ornamented with precious stones, to be made for the celebrated Evangelistarium written and illuminated by Eadfrith, Bishop of Lindisfarn, towards the end of the 7th century, and Rundell and Bridge's account for gold work on the binding of the early vellum printed Psalter in George III.'s Library amounted to nearly £100.

† "If it were allowed to yield here to such a digression, it would not be difficult to prove that, in all probability, the impression by blind tooling of figures on the skin employed for the covers of books, preceded every other impression on paper of figures engraved on wood or metal. The Italian word *stampare*, employed long before the invention of printing, and which was anciently used as applying to the action of pressing on the skin, is one proof of what we have just asserted."—"Libri, Monuments Inédits," p. 12.

as that detestable G. Orsino, who strangled his wife with his own hands."

Appended to this passage is the following note:—"Amongst the early Italian promoters of ornamental book-binding, we must also conspicuously mention the celebrated Cardinal B. Accolti, Cardinal Bonelli, La Compagnia della Pietà d'Empoli, Suor Anzola Contarina, Suora Constantia (?) the Dukes of Ferrara, the poet Luigi Alamanni, Ap. Philaretus, Antonio Bon, P. Cicogna, Doge of Venice, the Pasqualigo family, &c., &c."

One of the most remarkable Italian collections of the 16th century was that formed by Demetrio Canevari. His books were mostly bound in the same style, with a centre medallion in colour.

Th. Maioli adopted that liberal inscription which was imitated by Grolier, viz., "Th. Maioli et Amicorum." Heber was a true follower of these worthies; and Scott alludes, in the introduction to the sixth canto of "Marmion," to his not being one of those who "refuse to others what they cannot use."

> "Thy volumes, open as thy heart,
> Delight, amusement, science, art,
> To every ear and eye impart."

When we consider the magnificence of the bindings in which Maioli's and Grolier's books were clothed, I think we must marvel the more at their amazing liberality. The more common feeling would be that of the French collector who put on his book-plate the appropriate verse from the parable of the ten virgins:—"Ite ad mercatores et emite vobis"—Go to them that sell, and buy for yourselves.

It was common for the old collectors to use various emblems and devices for their books, and also to stamp mottoes on the sides. Maioli's inscriptions were—"Inimici mea michi non me michi," and the less known "Ingratis servire nephas." Grolier's mottoes were—"Portio mea Domine sit in terra viventium," and "Æque difficulter," when his enemies accused him of robbery, and before his honour was vindicated. Diana of Poictiers, besides the crescent, adopted an erected arrow, rising out of a tomb, with the motto, "Sola vivit in illo."

France.

Jean Grolier, born at Lyons, in 1479, and educated at Paris, entered the public service at an early age. He went to Italy on a political mission to Clement VII., and, at various times, made the acquaintance of the celebrated printers—the family of Aldus, of Budæus, Cœlius Rhodoginus, and Erasmus. He returned to France laden with bronzes, medals, and books, and thenceforward he chiefly occupied himself with the foundation of a splendid library, the patronage of artists, and the enjoyment of literary and courtly society. He died in October, 1565, and a portion of his library was kept together until 1675, when it was dispersed by public auction. Grolier was the founder of the French school of ornamented binding, and many of the beautiful volumes which were bound under his supervision remain unsurpassed. In this instance, the name of the employer has swallowed up the names of the employed, and we do not know what binders were employed by Grolier to bind his library.* It will be impossible, with the space at my disposal, to do more than allude to some of the chief collections. In France, women have been amongst the foremost to support the professors of the beautiful art of bookbinding. Most of the kings of France were collectors of elegant books, and many of them were egged on in their pursuit by their wives or mistresses. This was more particularly the case with Henry II., whose mistress, Diana of Poictiers, occupies a prominent position in records of Bibliomania, and a good specimen of the binding of a book, from the collection of Louis XIII. and Anne of Austria, with their initials, is shown in Fig. 4.* In the reign of Francis I., that king's books were bound with the arms of France and a salamander, and the letter F stamped in gold and silver. Those books which were bound for the Dauphin during the life of Francis, have a dolphin in addition to the salamander. Henry II. had the initials (H. and D.) of his own and his mistress's names interwoven and stamped upon his books, with crescents, bows, quivers, and other symbols of the chase, appropriate to the bearer of the name of Diana. In 1578, Nicholas Eve styled himself "Bookseller to the University of Paris, and Bookbinder to the King," and he and Clovis Eve produced some of the finest bindings ever seen in France.

In Lacroix's "Arts in the Middle Ages" mention is made of a singular binding said to have been invented by Henry III., after he had instituted the order of "Penitents." It consisted of a death's head and cross bones, tears, crosses, and other instruments of the Passion, gilt or stamped on black morocco leather, and having the device *Spes mea Deus*, with or without the arms of France.

The great De Thou (better known to bibliographers by his latinised name of Thuanus) must rank next after Grolier as a patron of bookbinding. He was master of the Royal Library under Henri IV., and the books were, by his directions, mostly bound in red morocco, stamped with the arms of France and the letter H in the four corners, sometimes followed by the number IIII. A few had the inscription, "Henrici IIII., patris patriæ virtutum restitutoris." De Thou's own library must have been a marvel of beauty, as all his books were bound with exquisite taste. The most usual style adopted by him was a plain side, with his arms in the centre, and his monogram repeated down the back. He used his own arms alone when a bachelor, but on his marrying he added his wife's, and afterwards those of his second wife were incorporated with his own and those of his first wife. Sometimes, however, he favoured a more elaborate system of gilding, and a very fine specimen of this style will be found in Fig. 2. On the death of his uncle, Christopher, in 1583, Mammert Patisson printed a quarto volume of elegies, and De Thou bound a large paper copy in olive morocco, with representations of tears upon the covers.

These books were all fine copies, as well as grandly bound ones, for De Thou engaged purveyors in all countries to secure large paper or fine paper copies for his library, and he selected the most beautiful sheets from two or three copies to form one unique one. The library was kept intact for over an hundred and seventy years after his death. He left it to his son, with strict injunctions that it should not be disposed of.

* A good specimen of Grolier's work is to be found in Fig. 1.

* This block has been kindly lent by Messrs. Morgand and Fatout, booksellers, of Paris.

This son, by the second wife, continued to add to the library, and to bind the books he obtained in the same style as his father. On his death, however, in 1677, it was decided that the library should be sold by public auction, and a catalogue was published. The President De Menars, purchased all the library, with the exception of the books in the first two days' sale, which were dispersed before he knew they were to be sold. He afterwards bought back some of these books. The library was subsequently bought from his heirs by the Cardinal de Rohan, who incorporated it with his own. The Prince de Soubise, who was the lineal successor to the Rohan property, sold the library by public auction in 1788. The British Museum is particularly rich in specimens of Thuanus, as the Rev. C. M. Cracherode, whose library now rests there, bought largely of these treasures at the sale.

Up to this time few names of French binders have come down to us, and it is the collectors only who are recorded; but, soon afterwards, the names of Le Gascon and Dusseuil come into marked prominence. The French are justly proud of Le Gascon, and it will be seen from Fig. 3* how beautiful his designs often were. He bound much of Sir Kenelm Digby's library, and Mr. R. S. Turner has one of these interesting books in his fine library. Dusseuil received the honour of mention by Pope in the fourth of his "Moral Essays":—

> "His study! with what authors is it stored?
> In books, not authors, curious is my lord;
> To all their dated backs he turns you round:
> These Aldus printed, those Du Sueil has bound!
> Lo! some are vellum, and the rest as good,
> For all his lordship knows—but they are wood!
> For Locke or Milton 'tis in vain to look;
> These shelves admit not any modern book."

The Brienne collection, sold in London in April, 1724, contained several hundred volumes bound in morocco by this artist, and this incident may have attracted the attention of the poet, who evidently knew little of the binder, as many of the books bound by him would most likely be modern. Of other great names it is only necessary to mention Boyet, Anguerand, Padeloup, Monnier, and De Rome. There were thirteen members of the family of Padeloup and eleven of the family of De Rome, although they were not all famous. With De Rome le jeune, who commenced business, the art died in France, and although Bozérian and Thouvenin tried to restore it, they are not now very highly esteemed. There is a very beautiful specimen of inlaid morocco by Monnier in the British Museum, the design of which strongly resembles embroidery. The French have always excelled in this style of binding.

The French consider Binding as a national art, and believe that they long ago distanced, and still excel, all other nations. When we look at the beautiful bindings which they have produced, we cannot but allow that they have great reason for their boast. At the same time, it is not creditable to us that we should know so little of the beautiful bindings of our own country. Many of these, although not equal to the finest productions of French art, are of a very high order of merit. It is also worthy of recollection that, at one time, there was a wave of Anglomania in France, which is alluded to by Lesné, in his poem on Bookbinding (1822), when speaking of Bozérian:—

> "Cet artiste amateur détruisit la folie
> De regarder l'Anglais avec idolatrie."

* This fine block was kindly lent by Messrs. Morgand and Fatout, of Paris.

England.

I will now pass on to consider more particularly the history of Bookbinding in our own country.

There is a large folio manuscript in the Manuscript Department of the British Museum (Add. 15,350) which is bound in white skin stained pink, and stamped with large roses and dragons in a floreated frame. This volume is supposed to have been produced at Winchester in the fourteenth century; in which case, it is an early specimen of an elaborate piece of leather binding.

Caxton was not a very excellent binder, and the designs on his books are of a simple character, much inferior to contemporary work abroad. The ordinary pattern he adopted, when he whole-bound, consisted of diagonal lines crossing each other, and forming lozenge-shaped compartments, in which were dragons and roses. Mr. Blades observes, in his "Life of Caxton," that the printer's sheets were not, as in modern practice, pressed between glazed boards after being printed, but went, without further process, from the press side to the hands of the binder; and he adds:—

"The edition of 'Eneydos,' 1490, was hurried through the binder's hands so soon after the first section (which, containing the prologue and table, necessarily went to press last) was printed, that all the leaves of that section, in every copy I have seen, show a very bad 'set-off' from the type on the opposite pages."

Pynson stamped his books with his device, as did also Wynkyn de Worde, who employed Nowel, a bookbinder in Shoe-lane, and one named Alard.

Pope writes ("Dunciad" I., ll. 149-150):—

> "There Caxton sleeps, with Wynkyn at his side,
> One clasp'd in wood, and one in strong cow-hide."

John Reynes, Bookseller and Binder, residing at the "George," in St. Paul's Churchyard, was an artist of some mark—the first Englishman, in fact, who did work that could at all compare with that produced abroad. His devices consisted of two small shields, with his initials and monogram, and these he usually introduced in a large design. In a show-case in the Manuscript Department of the British Museum is a good specimen, in stamped leather, with an ancient ivory of the crucifixion (fourteenth century work) let into the upper cover. The leather and pattern are very roughly cut into for the purpose. The volume has Reynes's monogram on the side, and a very elaborate back. Mr. Libri remarks, in a note to his catalogue—

"In some of the most elaborate of Henry VIII.'s blind-tooled books, the instruments of the Passion are accompanied with the inscription, 'Redemptoris mundi arma,' a curious application of heraldry to the bibliopegistic art by the King's binder, John Reynes, to whom this device is attributed by Ames."

Many books appear to have been issued during the reign of Henry VIII. with the Tudor rose and royal arms embossed upon the old brown leather cover, which did not belong to the King.

There is a vellum MS., by Skelton, at the British Museum, which has the Tudor rose supported by angels, with the motto round it, "Hec rosa vir-

tutis de celo missa sereno eternum florens regnia sceptia feret," on the top side of the book, and the royal arms, with supporters, on the under side. This is to be seen on numerous other specimens. Skelton himself was enthusiastic in praise of the bookbinding of his time, and writes :—

"It would have made a man hole that had be right sickly,
To behold how it was garnished and bound,
Encoverde over with golde and tissue fine."

Other binders of this period, whose names have come down to us, are Michael Lobley, William Hill, and John Toye.

Thomas Berthelet, the King's printer, also bound largely the books he sold to Henry VIII.* Most of the work done for Henry VII. and Henry VIII. was in blind tooling, and of a bold and effective character, but with little pretension to delicate art. There were, however, some effective bits of gilt tooling produced for the latter king.

In the twenty-fifth year of Henry VIII. (1533), an Act of Parliament was passed, in the interest of English bookbinders, which was not repealed until the twelfth of George II., by which it was enacted "That no persons, resiant or inhabitant within this realm, after the feast of Christmas next coming, shal buy to sell again any printed books brought from any parts out of the king's obeysance, ready bound in boards, leather, or parchment, upon pain to lose and forfeit, for every book bound out of the said king's obeysance, and brought into this realm, and brought by any person or persons within the same to sell again, contrary to this Act, six shillings and eight pence."

In the reign of Edward VI., Grolier patterns were introduced into England. Some specimens of an elaborate and very artistic character have come down to us, while in some few instances that I have seen, the design has been badly executed. A plain, but elegant representation of one of Edward the Sixth's books is given in Fig. 6. There is a very elaborate binding of a book which once belonged to Queen Mary I. in the show-case at the British Museum. It is in Gothic style, with painted leather, and painted arms in the centre of the side. Considerable sums were paid for the binding of these books, as may be seen by reference to the Household and Wardrobe accounts of the time, and one naturally wishes to know the name of the artists; but, as has already been remarked, we are constantly thwarted. It would, therefore, be some satisfaction if we could associate a very choice piece of binding with the name of an eminent printer. In the British Museum is the presentation copy, from Fox, the martyrologist, to Queen Elizabeth, of "The Gospels of the Fower Evangelists. Printed by John Daye," 1571. It is bound in brown calf, with a centre block, and corners inlaid with white kid, or morocco. The royal arms and E. R. are tooled on the calf, which is also beautifully studded with gold. There is an exquisite design worked on the white leather, in which the initials "I. D. P." are introduced, Mr. Charles Tuckett, who gave a plate of this in his "Specimens of Ancient and Modern Binding," expresses the opinion that these may be intended to stand for "John Daye, printer." As, however, another book presented to Queen Elizabeth, but not printed by Daye, which is also in the British Museum, has the same binding, I am afraid the conjecture cannot be accepted. Fig. 7 represents an elegant binding executed for Elizabeth when Princess, with the badge of her mother, Anne Boleyn, which she bore before she came to the throne.

Robert Dudley, Earl of Leicester, made a good collection of books, which were stamped with his device—the bear and rugged staff. In many instances, the binding is plain, and the device alone appears on the side; but, in the specimen given in Fig. 8, there is a considerable amount of ornamentation. Fine specimens of binding have also come down to us from the libraries of such eminent men as Archbishop Parker and Lord Treasurer Burghley. Even the fierce Bothwell possessed some finely bound books.

James I. was an ardent lover of good binding, and he indulged his taste in this matter when he was simply James VI. of Scotland. John Gibson, of Edinburgh, held the office of royal binder, with an annual salary of £20 Scots; and, if Mr. Tuckett is correct in ascribing to him a volume in the British Museum, bound in dark green Venetian morocco, he must have been a very considerable artist. This book, which is Thevet's "Hommes Illustres, 1584," is ornamented with elegant gilt scroll-work and the royal arms in the centre. The British Museum contains many other magnificent specimens of work done for this king, some ornamented with thistles, and others with fleurs-de-lys, and, in certain cases, both are combined.

In the calendar of State papers there is an entry of a warrant to pay John Norton £173 16s. 4d. for binding sundry books, covered with velvet, &c., for the King's service, dated November 13th, 1609,* and on December 20th of the same year there is a warrant to pay Rob. Barker £310 14s. 8d., for printing and binding sundry books.†

Henry, Prince of Wales, exhibited the same taste as his father, and gathered together a very fine library; most of these are ornamented with the Prince of Wales's feathers, and sometimes with fleurs-de-lys, in the four corners of the sides. Figs. 9, 10, 11 represent bindings of this accomplished young prince.

In spite of an enlightened appreciation of fine binding among those classes who could afford to pay for the luxury, the good binders living at one time must always have been few in number. The majority of the craft were occupied in a more wholesale business. I, therefore, propose to make a passing allusion to some of the latter tradesmen. The Stationers' Company made some stringent rules as to the binding of certain classes of books, and we learn that, in 1566, William Hill, originally a printer, was fined for binding primers in parchment contrary to the Company's orders. In August, 1637, the Bookbinders of London presented a petition to Archbishop Laud, at Croydon, in which "they prayed that no books might be sent into the country in quires to be bound; that it should be ordered what books are to be bound in sheep, and that there may be a certain price set down by the Company in a table, and fixed in Stationers'-hall; that there may be a restraint of binding apprentices, and that

* See his bill (1541-43) printed in "British Archæological Association Journal," vol. viii. (1853), p. 44.

* "Calendar Domestic," 1603-1610, p. 559.
† P. 574.

bookbinders free of other companies than the Stationers' may be conformable to the orders of the Stationers' Company."* We know that many binders were free of other companies, and in the "Remembrancia" there is an allusion to one named Harny, who belonged to the Fishmongers' Company about the year 1577. We further learn, from the State papers, that in September, 1652, the Primer binders petitioned the Council of State, and that their petition was referred to the Committee of Examinations for Report.†

One of the most interesting chapters in the history of Bookbinding in England, which has still to be written, will be that which contains the history of the Ferrar family. Nicholas Ferrar retired to Little Gidding, in Huntingdonshire, with a colony of relatives, in the year 1624, and founded there a religious establishment, which, on account of the number of female inmates, was styled by the ignorant neighbours the *Protestant Nunnery*. In "The Life of Ferrar," by Dr. Peckard, we are told that:—

"Amongst other articles of instruction and amusement, Mr. Ferrar entertained an ingenious bookbinder, who taught the family, females as well as males, the whole art and skill of bookbinding, gilding, lettering, and what they called pasting-printing, by the use of the rolling-press. By this assistance, he composed a full harmony or concordance of the four evangelists, adorned with many beautiful pictures, which required more than a year for the composition, and was divided into 150 heads or chapters. For this purpose, he set apart a handsome room, near the oratory."

Several copies of this work were compiled and given to friends, one of these being George Herbert, the poet, after which its fame reached Charles I., who asked for one to be prepared for him. This was shortly afterwards produced, and the "book was bound entirely by Mary Collet (one of Mr. Ferrar's nieces), all wrought in gold, in a new most elegant fashion." Most of the bindings executed at Little Gidding consisted of embroidered covers of rich velvet, but the Ferrars did also produce some bindings in leather. There is, in the Manuscript Department of the British Museum, a volume of "The History of the Israelites," dated 1639, which consists of a sort of Harmony of the Books of Kings and Chronicles. It is bound in dark morocco, with gilt line tooling on the side forming a series of oblong squares one within the other, gilt lines cross the back, and C. R. stamped at the foot. The volume is of great interest as a highly characteristic piece of binding. The "History of the Israelites" was prepared at the special desire of the king, who had frequently moved his chaplains to undertake the business without success. The copy presented to Charles is described as having been bound in velvet, most richly gilt; so that it is doubtful whether the morocco copy described above was a duplicate, or whether the velvet was a cover over the leather.

Bishop Cosin was a *connoisseur* in binding, and gave very full instructions to Hugh Hutchinson, the binder he employed. For instance, in 1671, he writes to his secretary, Miles Stapylton:—

"Where the bookes are all gilded over, there must bee of necessity a piece of crimson leather set on to receive the stamp, and upon all paper and parchment books besides. The like course must be taken with such bookes as are rude and greasy, and not apt to receive the stamp. The impression will be taken the better if Hutchinson shaves the leather thinner."

Large sums were paid by Cosin to Mr. House, the goldsmith, who prepared the metal work for the ornamentation of certain of the books.

Samuel Pepys was very choice in his books, and liked to have some specimens of the work of good binders in his collection. He mentions with commendation Nott, who bound Lord Chancellor Clarendon's library, but he does not tell us the names of those who put the gilding he so much admired upon the backs of his books.

Some very elaborate and beautiful inlaid work with filagree tooling was done in England near the close of the seventeenth century, specimens of which are in the British Museum. I wish that we had means of finding out who were the artists, so that we might give honour where honour is due.

In that curious book, Dunton's "Life and Errors," several binders are mentioned, but they were mostly binders of long numbers. Honest Dick Janeway is said to be "an excellent binder and a tender husband." We are also told that Edmond Richardson, of Scalding-alley, "bound most of my calves leather books whilst I lived in the Poultry," and that Thomas Axe was "my chief binder for ten years." Baker, in Warwick-lane, "binds so extraordinary well, that two of my customers gave particular charge that no man in London should bind the books that they bought of me but Mr. Baker and Mr. Steel." Steel's binding, "for the fineness and goodness of it, might vie with the Cambridge binding." Mitchel, in Christopher's-alley, "was a first-rate binder," and Caleb Swinnock was the only man who could ever tempt Dunton "to take sheep's leather books at 14s. the hundred."

The Harleian Library, founded by the Prime Minister, Robert Harley, first Earl of Oxford, and continued by his son Edward, second Earl, was bound in a handsome manner, at a total cost of

* "Calendar of State Papers, Domestic," 1637, p. 350.
† "Calendar, Domestic," 1651-1652, p. 394.

£18,000. The style adopted for many of the volumes consisted of a broad tooled border with centre panels, and the material was usually red morocco. The above figure represents the ordinary border known as the Harleian.*

Elliott and Chapman, binders of some eminence in their day, were employed by the Earl of Oxford, but Wanley, that nobleman's librarian, had trouble with their bills occasionally, as they did not like the system adopted of supplying them with "my lord's leather." Mr. Chapman wanted to buy some of the morocco skins at a cheap price, but Wanley told him that "my lord will not turn leatherseller." Sometimes the binders were supplied with doeskins, which were to serve instead of calf, but the grain was found to be coarser, like that of sheep.†

Thomas Hollis was accustomed to decorate his books with emblematical devices appropriate to their several subjects. He employed the celebrated artist Pingo to cut a number of tools for stamping on the sides and backs. The caduceus of Mercury was used for books of oratory and eloquence, the wand of Æsculapius for medical books, the cap of liberty for patriotic works, an owl for philosophy, and the pugio, or short sword used by the Roman soldiers, for military subjects. This style of binding was continued by Thomas Brand (Hollis), to whom Hollis left all his property and his name.

About the beginning of the second half of the eighteenth century arose Roger Payne, the most celebrated personage in the history of English Bookbinding. This remarkable man was a native of Windsor Forest, and was apprenticed to Mr. Pote, the Bookseller to Eton College. When he first came to London, he was employed by Thomas Osborne, and afterwards was established in business near Leicester-square, by Thomas Payne, the bookseller, about the years 1766-1770. He cut most of his tools himself, and formed a great variety of beautiful designs by combining them. His bills were very characteristic documents, and on that account many of them have been preserved. Here is part of the description of the work on "The Harmony of the World," by Haydon, 1642, which he did for Dr. Mosley:—"Bound in the very best manner, the book sewed in the very best manner with white silk, very strong and will open easy; very neat and strong boards, fine drawing paper inside, stained to suit the colour of the book. The outsides finished in the *Rosie-Crucian taste*—very correct measured work. The inside finished in the *Druid taste* with acorns, and S. S. studded with stars, &c., in the most magnificent manner. So neat, so strong and elegant as this book is bound, the binding is well worth 13s., and the inlaying, the frontispiece, cleaning, and mending is worth 2s."

The prices charged by Payne were very low, considering the amount of labour he lavished upon his work. He only charged 3s. 6d. for cleaning and repairing Hughes's "Natural History of Barbadoes," with green morocco joints.—"Nat. Hist. Green, a proper colour,—very fine and strong drawing-paper to suit the colour of the paper of the book, a fine sheet at the beginning and end of the book, and the sides of the boards covered with the same fine drawing paper; the title was very dirty, which I have cleaned and mended as neat as I possibly could; the corners of the boards wanted a little mending, and the roughness of the leather put to rights as much as possible. I have done every thing according to order, to do the best—make the book a fine copy.—3s. 6d." *

Roger Payne's masterpiece was a copy of the Glasgow "Æschylus" (1795) in the possession of Lord Spencer, the binding of which cost the Earl £16 6s. 10d. His favourite colour was a pale olive, called by him Venetian, and his style of ornamentation consisted chiefly in elegantly designed borders. The annexed figure is a characteristic representation of his ordinary border.† He



seldom put much tooling on the side, and his strength lay in the appropriateness and charm of his designs. A short time before his death, he worked for John Mackinlay, one of the best London binders of his day, who has the credit of having been the instructor of most of the celebrated artists who succeeded him. Payne died on 20th November, 1797, in Duke's-court, St. Martin's-lane, and was buried in the churchyard of St. Martin's-in-the-Fields, at the expense of Thomas Payne, the bookseller. In all notices that I have ever seen of Roger Payne, allusion is made to his besetting sin; but I do not find that the private character of any other binder has been specially censured, so that I think we may well pass Payne's by without remark. Richard Wier was at one time partner with Roger Payne, previous to which he and his wife were employed at Toulouse, in binding and repairing the books in Count Macarthy's library, where they succeeded De Rome. Mrs. Wier, as the most complete book restorer that ever lived, had her portrait taken, a copy of which is given in Dibdin's "Bibliographical Decameron."

No one has arisen to rival the fame of Roger Payne, but England has produced many good binders since his time. H. Walther followed in his steps, and did very good work. Kalthoeber, Staggemeier, H. Falkner, Charles Hering, John Whitaker, and Charles Lewis are all names of

* This block is lent by Mr. J. Zachnsdorf.
† Edwards's "Memoirs of Libraries," ii., 972.

* A facsimile of one of these bills is given by Mr. Cundall, in illustration of his paper on "Bookbinding."—"Transactions of the Society of Arts," supplemental volume, 1843-47.
† This block is lent by Mr. J. Zachnsdorf.

note. Kalthoeber had the most distinctive style of all, and his bindings can be easily identified by the tooling on the back, which always took the form of a star or a circular ornament of some kind. He was chiefly noted for his Russia bindings, but I have seen some elegant specimens of his ornamentation of calf. Lewis was the reigning binder during the period when that strong wave of Bibliomania, which Dr. Dibdin commemorated in his handsome books, passed over England. It was Lewis and Clarke who bound nearly the whole of the Rev. Theodore Williams's fine library.

Gosden was famous for his emblematical tooling for books on angling, Johnson was noted for his light calf, and many other binders have had their specialty. After Lewis came Clarke and Bedford, a firm which was afterwards dissolved, and Mr. Bedford still lives to delight the lovers of good binding.

Although most of the English binders who have attained fame have been connected with London, there are a few instances of others who deserve some notice. Roger Ascham mentions Garret, a bookbinder at Cambridge in the middle of the sixteenth century. A few years later, Dominick and Mills had gained such fame at the sister university that many Oxonians considered them superior to London Binders. They appear to have been employed by Sir Thomas Bodley to bind his books on the recommendation of his librarian, Dr. James. Both Oxford and Cambridge have been noted for their distinctive styles of binding. One of the artists, to whom much of the good Cambridge work of the last century is due, was a binder named Dawson. Horace Walpole was told that the binding of vellum was better done in Dublin than elsewhere, and he was, therefore, anxious to have a good specimen sent to him. When the advice of the celebrated William Roscoe was asked, as to the binding of the valuable MSS. at Holkham, he recommended John Jones, a Liverpool binder, as a fit man to superintend the work.

> "With joy the rescued volume see,
> Where Sarpi wakes the patriot soul,
> And the bright glance of liberty
> Shot from beneath the monkish cowl." *

I have already alluded to the Ferrar family, and I may here make a passing note upon some other amateur binders. The celebrated Hon. Roger North was fond of the art, and William Hutton followed it at Southwell, Notts. I believe that I may add to this small list the illustrious name of the late Prince Consort. Michael Faraday never, probably, turned out any work of importance, but all binders must be proud to remember that the great philosopher was apprenticed to a bookbinder in Blandford-street when only nine years of age.

Bookbinding as a Fine Art.

I now pass on to consider Bookbinding as a Fine Art, and here I feel that I am treading upon dangerous ground and walking without a guide. All agree that binding should take rank among the decorative arts, but I do not find that any principles have been evolved for the guidance of the binder, or that any definite indication of the points of its connection with or divergence from other arts has been satisfactorily set forth.

De Quincey, in alluding to the choice of the trade of bookbinding by the Ferrars, writes:—"Why this was a good trade to choose, I will explain in a brief digression. It is a reason which applies only to three other trades, viz., to coining, to printing books, and to making gold or silver plate. And the reason is this—all the four arts stand on an isthmus, connecting them, on one side, with the vast continent of merely mechanical arts; on the other side, with the far smaller continent of fine arts."* This is true in a double sense, for in one point of view, every good binder who tries to work out an idea is an artist, whether the result is plain or ornamental; and, in another, the finished side of some richly tooled book is as much a work of art as any picture or drawing.

Clearly all books should be kept in good condition, and we cannot but approve of the conduct of the King Alphonsus, of whom Peacham (English Gentleman) tells the story that, when "about to lay the foundation of a castle at Naples, he called for Vitruvius, his book of architecture. The book was brought in very bad case, all dustie, and without cover, which the king observing, said—'He that must cover us all, must not goe uncovered himselfe.' He then commanded the booke to bee fairely bound and brought unto him."

Locke loved a handsomely-bound book, and wrote to his friend Anthony Collins, in 1704:—

"I beg the favour of you to get me Le Clerc's 'Harmony,' bound very finely in calf, gilt, and lettered on the back and gilt on the leaves. . . . I like to have things . . handsomely made, and fitly adapted to their uses. If either were necessary, I had rather be taken notice of for something that is fashionably gaudy, than ridiculously uncouth."

Some think this is an extravagance, but Roscoe pertinently remarks, in his "Life of Lorenzo de Medici":—"It is difficult to discover why a favourite book should not be as proper an object of elegant ornamentation as the head of a cane, the hilt of a sword, or the latchet of a shoe."

The man, who is particular about his bindings, will often be in a state of fear and trembling when those who do not understand books attempt to handle his treasures. It is related that the Superintendent Fouquet had a pile of white gloves in the ante-room of his library, and no one was allowed to proceed further until duly provided with a pair, lest the books within should receive a soil from the naked hand.

I think we may safely say that binding, to be a fine art, must be the outcome of an honest and original attempt to adapt beautiful forms to the special purpose of adorning a book. Moreover, appropriateness must be the binder's guiding principle; for, however beautiful the design may be, it becomes bad art when applied to a purpose for which it is unsuited. Pictures or drawings are beautiful in themselves, and the responsibility of placing them in a good position lies with the hanger; but the picture on the side of a book must correspond with the subject of the book, and with the colour and material of the cover upon which it is worked. Old bindings have one immense advantage over modern ones in the mellowness of the gilding, which time only can give; but we should not be seduced by this into admiring bad art, for it must be allowed that all the elaborately-gilded bindings of past times are not necessarily in good taste.

* Edwards's "Memoirs of Libraries," ii. 156.

* Works, vol. 6, page 249.

There are three totally separate styles of art to be distinguished in the history of Bookbinding, and each one of them appears to have been uninfluenced by the others. These are exhibited in (1) the old stamped leather, which was brought to perfection by the Germans; (2) the gilt tooling which came to us from Italy; and (3) the blocked covers of modern cloth bindings.

1. In the first instance, the ornaments on the leather were of the simplest description, and merely intended to hide the bareness of the side. Afterwards, an elegant artistic taste came into play, and many of the stamped calf, vellum, and pigskin covers became—thanks to the designers of the blocks—marvels of delicate treatment. A considerable variety of design was indulged in, and portraits, and other illustrations of the contents of a book, were often stamped upon its cover. All this ornamentation was blind work, and the scrolls, and flowers, and mottoes were only shown by their slightly elevated surface over the rest of the cover.

2. The gorgeous gold tooling which flourished for many years, and gradually drove blind tooling out of fashion, came to us from Italy; but there is no doubt that it had an Eastern origin. Some of the earliest Italian ornamental bindings are evident imitations of the covers of Persian and Arabic MSS. There were two styles which were more particularly copied, viz., the corded and dotted patterns, and those in which large surfaces of solid goldwork were spread over the side. There was, I think, another influence at work in the formation of a highly ornamental style, and this was the old chased silver covering which were evidently imitated in some of the elaborate designs in leather.

3. The artistic effect of some of the best cloth covers is very remarkable, and this is due to the employment of first-rate designers whose aim is to produce a binding appropriate to the subject of the book. There is one point of especial interest in respect to cloth binding, and that is that we can claim the art as entirely an English one. I need not say more here on this subject, as I have still to add a few words on cloth binding under the heading of *Bookbinding as a Manufacture*; but I will just remark on the point that, in the production of the earliest and latest classes of binding, block stamps have been used.

I have already referred to the first of these divisions, and will now treat more particularly of the second.

Maioli and Grolier were friendly rivals in the patronage of bookbinding, and both of these worthies adopted the geometrical patterns that so soon spread over the whole of Europe. These patterns became popular in England in Edward the Sixth's reign, and elaborate designs were very generally adopted here. It is a question that has yet to be proved, whether this work was done by Englishmen, or whether foreigners were brought over to supply materials for the refined taste of the upper classes. Grolier appears to have taken Italian workmen with him on his return to France, to teach his countrymen the elaborate art. They were apt scholars, and, as time passed on, taste in binding decayed in Italy, and made its permanent home in France. We speak of the Grolier style, but the number of styles which this magnificent patron of the art introduced is legion. First there are the somewhat stiff geometrical patterns, then the more easily linked ones, and, lastly, those in which some flowery ornament is added. Fig. 1 is a good specimen of this last. Grolier appears to have been always anxious to improve upon his patterns. Sometimes, the results were scarcely satisfactory, and I venture to think that the architectural designs upon some of his books are inappropriate.

After the death of Grolier, the binders eliminated the geometrical forms more and more, and replaced them with representations of flowing leaves and boughs of trees. Nicholas and Clovis Eve obtained very beautiful effects by a quite novel treatment of foliage, and also by an elegant repetition of special objects. New conditions were submitted to these binders, and they surmounted the difficulties of arrangement with consummate taste. Grolier and Maioli very occasionally introduced arms into their bindings, but the binders employed by the royal family of France had to make arms, monograms, *fleurs de lys*, and many other devices the main features of their designs. What splendid effects they obtained by the judicious mixture and repetition of these ornaments is known to all who are familar with the triumphs of the French Bibliopegistic art. The Eves were almost the only binders who succeeded In making the two sides of a book and its back the three parts of one congruous whole. The backs are without bands, and the square lettering is in pleasing contrast to the flowing beauty of the ornament.

Le Gascon and Dusseuil were the producers of much artistic work. The work of the former (Fig. 3) is a magnificent specimen of elaborate French ornamentation, which leaves little to be desired. Padeloup and De Rome did not bind so elaborately as their predecessors, but their work is of a distinguished character. De Rome was famous for his gilt borders.

Roger Payne was a true artist, and his dominant idea was the adoption of ornament appropriate to the character of the book. This is apparent from the wording of his bills, as he was able to give reasons for the adoption of his various designs. His backs were usually fully gilt, but his sides were seldom ornate. In most cases, he confined his tooling to the corners. It must be allowed that, although Roger Payne was the most celebrated of English binders, he was not equal to the great French binders. It is, however, a remarkable proof of the excellence of English bookbinding in the last century, that a series of annuals, such as Rider's almanacs, should have been for more than a hundred years elaborately bound in red morocco, with a constant change of design. Fig. 5 is taken from one of the year 1752, and I have seen others still more beautiful. A particular style of binding, called the Etruscan, was introduced by John Whitaker, in which designs from Etruscan vases were copied in their proper colours, instead of in gold tooling. This fashion had considerable vogue for a time.

At the period of the Revolution, art died completely in the hands of the French bookbinders, and, when there was an attempt to revive it, the eyes of France were turned towards England for inspiration; but the French binders long suffered from the difficulty of obtaining a good

morocco. The English binders were not, however, sufficiently artistic to be able to retain this influence, and the French again took the lead by studying the works of their own masters. In the earlier ornamental binding, effects of colour were largely obtained by adding a thickish paint to the leather, and inlaying was not a general practice. In the last century, it became more common, and now it is a distinguishing characteristic of the French binding. It has very frequently been felt by men of taste, that the ordinary marbled papers, when used as linings, were in too violent contrast with the richly gilt sides, and various attempts have been made to obviate this objection by the use of silk, and other ornamental materials. The French binders introduced a system of lining the inside cover with leather, which was sometimes also richly gilt; this is technically called *doublé*. This practice was adopted in the East at a very early period, and I have seen a Persian MS. of the 15th century with a highly ornamental leather lining inside, so that the French only transplanted to Europe what had long been common where so much of one art had its first home. I venture to think that this practice is inappropriate, and in bad taste, as it answers no useful purpose. I put forward this opinion, however, with some diffidence, as I believe that I am in a minority. The French binder, Mons. Trautz-Bauzonnet, who died lately, was a great master in the art of inlaying, and his works are highly appreciated by connoisseurs. At a late sale in Paris, a book of no very great value, bound by him in his best and most elaborate style, sold for £640. By no possibility could the book itself have been valued at more than between one and two hundred pounds; so that at least £440 was given for the binding alone. It was considered as a work of art like a picture or a piece of china that could not be replaced, and fetched a high price accordingly. I should like to make this incident a text for the few final remarks on the point we are now discussing, because it brings out very strongly the difference in the estimation of binding here and in France.

I fear that we must answer the question, Is Bookbinding a living Fine Art? in the negative, because the greater part of the work now produced is imitative, and imitation always leads to the death of art. Then comes the further question, can the art be revived? Surely it might be, if the true principles upon which it is founded are mastered. As artists, such as Holbein, Petit Bernard, and many others, have given designs to the bookbinder, so the artists of the present day might do the same, But the designs must be specially adapted for the purpose for which they are intended, and should, in many cases, be indications for the guidance of the artist-binder rather than finished drawings. Binders are particularly liable to the difficulty of not knowing exactly where to stop. They may add to an already beautiful design, and spoil it in the process.

It is, however, hopeless to expect the art to revive until some means are taken to raise the standard of appreciation in which Binding is here held. There are now few *connoisseurs* who understand the principles of artistic binding, and many men and women, who would be ashamed to admire a bad picture, will admire a gaudily-bound book by an inferior workman.

Why does Binding flourish more in France than in England? The natural answer is, because, abroad, there are more collectors who possess small cabinets of well-bound books. It has been remarked that, in spite of our boasted culture, few houses of well-to-do persons contain any handsome books. Now, most of us have one or two favourite authors. The works of these should be possessed in the best editions, and the handsomest covers. Other books might be ordinarily clothed, but those which the owner delights to honour should have ornament lavished upon them. If this feeling became general, we should soon see a revival in the art of bookbinding; but I must add one caution. Good binding will always be expensive, because it takes much of the time of a good workman. The lover of binding, therefore, must not grudge the price, or, if he does, he will not get good work.

Binding as a Mechanical Art.

In treating of bookbinding as a fine art, I have alluded to the comparative state of decadence into which it has fallen at present; but, now that I come to consider binding as a mechanical art, it is necessary to state that never was that in a higher state of perfection than at present. Much of the old binding is a marvel of strength: but it is also clumsy. The wooden boards, with leather bands, or thongs, wedged into the holes made for them with wooden wedges, give the book they cover the appearance of pieces of furniture. Petrarch found out the dangerous massiveness of these books when he dropped his own transcription of Cicero's "Epistles" upon his leg, which he injured so much as to narrowly escape amputation. In some specimens of ornamental tooling, the lines are not always straight, and they often do not join as they ought. Moreover, many books, the covers of which are marvels of artistic treatment, exhibit a certain rigidity about the joints. None of these flaws are to be found in good work of the present day, which is usually perfect from a mechanical point of view. The aim of the binder for many years has been to unite strength and elegance; and there are morocco bindings which will probably outlast the books they cover. The binder, to be successful, must have an artistic eye, and nearly all his work must be done by hand. Few trades have been less able to avail themselves of machinery than his; so that a picture of the middle ages, showing a binder at his work, differs little in detail from what may now be seen in any shop in London; the same hammer and the same sewing-press are exhibited in both. The cost of binding has increased of late years, owing to increase in the workmen's wages, and leather is almost double the price it was fifty years ago, but the difference in the relative cost of morocco and calf has somewhat lessened. Even now, I think we must allow that the price of ordinary leather bindings is very low, considering the amount of work which must be put into each book.

What is called "extra," as distinguished from "common" work, is dealt with under the two great divisions of "Forwarding" and "Finishing." The mode of binding a book has so often been described that it is not necessary to give any details here; but I will set down the various processes, in their

successive order, to show how much there is to be done to a book between the time it enters and the time it leaves the binder's shop, and also that I may be able the better to refer to some of the points that seem to need fuller notice. The various operations which go to make up the "forwarding" of a book are—folding; collation; beating by hand, or rolling in a machine, to make the book solid; re-collation, placing of plates, guarding of maps, &c.; pressing in sections; marking up for flexible backs, and sawing in for open backs; sewing; adding of end papers; glueing back; rounding back; backing; putting on the boards; pressing; cutting; colouring, marbling, or gilding the edges; headbanding; lining up; covering; pasting down. In the "finishing" is included preparing the leather; the tooling on the back, sides, and inside; and the lettering.

Folding.—The first item in the above list is the folding of the sheets, and this opens up the whole question of the sizes of books; but I must not be seduced into dwelling upon this difficult point here, as it is too large a matter to be brought in parenthetically. While bibliographers are in confusion from the varieties of machine-made papers now in use, which make the old names meaningless, the binders continue to use a system of the finest gradations of size, regulated by the length and breadth in inches of the paper. Octavos, quartos, and folios are divided into foolscap, crown, copy, demy, medium, and royal; duodecimos only into demy, medium, and royal; and octodecimos into crown, demy, medium, and royal.

Backing.—Hollow backs are a comparatively modern invention, and came into use about the middle of the last century. In order to prevent the bands from interfering with the back, a saw is used to make an opening for the cord to rest in, and not project above the paper; this is called sawing in. The back of a bound book, however, usually looks so unfinished without bands, that false ones, consisting of strips of stout leather or cardboard, are usually glued on to the back. In many of the old French ornamental bindings, the backs were without visible bands. These were not, however, sawn-in, but the bands were hammered flat, and then covered.

It is usual, after the sheets have been sewn and the back has been glued, to round the back, by a dexterous use of the hammer; but this is not always done, and a very marked instance of the opposite practice is to be found among the books of the late Rev. Theodore Williams, who insisted on having all the backs flat. These books are splendidly forwarded, and will fold right back with the greatest ease; but they are apt to get out of shape, and they are certainly not to the general taste.

End-papers.—The choice of suitable end-papers requires considerable taste in the binder, and many books have been spoilt by the incongruity displayed in their selection. Many very beautiful papers are now made, and there is an ample assortment of marbled and ordinary coloured papers to choose from. A paper stained in various shades and colours, and known as "Cobb paper," is generally used for half-calf bindings. I find, in a little book called "The Bookbinders' Manual" (1829), a curious account of the origin of this name, which is well worthy of quotation here, more particularly as I do not think that it is generally known.

"Some years ago the sides of boarded books were usually covered with blue or marble paper. Mr. Cobb, a paper-maker, obtained a patent for the manufacture of paper coloured in the pulp, which he proposed should be used for writing upon. The public, however, did not fall into his plan, and a large quantity of this paper came into the market cheap, some of which was purchased by a Bookbinder, who used it to cover the sides of some common books, as a substitute for marble paper; this was much admired, and the use of coloured paper for the same purpose soon became generally adopted, and occasioned a great demand for Mr. Cobb's patent paper, which was thus, as it were, by accident, brought into general consumption."

Boards.—The stages of change in the boards of a book from the thick wooden cover to the thin mill-board are worth recapitulation:—1. Books were bound with thick wooden boards, without any covering; 2, the back was then covered, to hide the leather thongs; 3, the whole of the sides were next covered; 4, the boards were made thin and shapeable; 5, pasteboard (made of layers of paper) replaced the wooden boards; and solid mill-board (made from pulp) as now used, replaced pasteboard.

Edges.—The cutting of the edges of a book is a delicate operation, and some binders have gained an unenviable notoriety for "cropping." John Locke, writing to his friend Anthony Collins, on the binding of a Greek Testament, says that nothing offends him "but the running of his [the binder's] paring-knife too deep into the margin; a knavish and intolerable fault in all our English bookbinders." This, however, is a sin which good binders religiously avoid. Here the need of careful folding is seen, for we sometimes come upon a book in which this essential has been neglected, with the result that the plough has taken off some of the letterpress with the margin, a misfortune which is technically styled "bleeding."

In old books more attention was paid to the edges than is common now, and on the fore-edge the title was usually written or stamped. The back was often left comparatively plain, while ornament was lavished upon the leaves, which were embossed or *gauffré*. Mr. Libri mentions in the preface to his catalogue a fine specimen of binding in his possession, that formerly belonged to Francis I., which has the words "Fr. de Valois" impressed upon the embossed leaves. Sometimes, fine drawings were painted upon the leaves, to be seen only when opened in a particular way. This art of painting landscapes and other designs upon the leaves of books was revived at the end of the last century, and many books at the beginning of the present century were so decorated. The ordinary mode of treating the edges of books is either by sprinkling, colouring, marbling, or gilding. Marbled or red edges under the gold always have a rich effect.

Head-bands, which finish off the top and bottom of the back, should be worked by hand, and form an integral part of the book by being fastened to several of the sections; but it has now become general to use a machine-made head-band, which is merely an ornament. This "improvement" is usually supposed to be a modern invention, but it

will be found occasionally used in books nearly two centuries old.

Leathers.—A large number of different leathers have been used at various times for the covering of books, but the finest of all—morocco—did not come into general use before Grolier's time. The old leather used appears to have been a kind of calf, but of a much stronger and more durable character than that now in use. Vellum, which is a special preparation of the skins of animals, was used at an early period, and its fame for durability has always stood very high. At first, it was used without any ornamentation; but, after a time, stamped vellum came into fashion. Much of the old Italian was ornamented with gold tooling, and we have evidence that gilt vellum was popular in the seventeenth century from a passage in Webster's play, "The Devil's Law Case" (1623), where we read:—

> "There is, in my closet,
> A prayer book that is covered with *gilt vellum*;
> Fetch it."

On the whole, however, we may safely say that the majority of old vellum-bound books are unornamented, and a large number of these are bound without boards. Hogskin and pigskin were formerly much used, and they form very strong materials, but they have of late years gained an unenviable notoriety from their supposed liability to the ravages of the bookworm. Although the skins of seals and sharks, of kangaroo, and various other animals, have been used for the covering of books, morocco, Russia, calf, sheep, and roan, which is a preparation of sheep, continue to form the binder's main stock in trade. John Whittaker bound a copy of "Turbeville on Hunting" in deer skin, on the cover of which was placed a stag in silver, and Jeffery, the bookseller, bound Charles James Fox's historical work in fox's skin. It is even said that books have been clothed in human skin, both in France and England; but this is too unpleasant a subject for us to make too particular inquiries respecting it.

The manner of preparation of some of the finest goat-skin has been pretty successfully kept a secret, for although morocco is manufactured both in France and England, the best quality still comes from Morocco. The specially-dyed leather which is known as Spanish morocco, can only be obtained in Spain, and no imitation of it has been successful. The Spaniards themselves imitate the colouring and grain in sheep. Russia leather, made from calf, cow, and ox-hides, can only be obtained from the country which gives it a name. Its delicious odour is obtained by a particular treatment with the empyreumatic oil of the birch. Calf is much stronger in its natural state than after it has undergone dyeing; but law calf, which is blacked with acids in order to give it its underdone pie-crust colour, is still less durable than dyed calf.

The general adoption of half binding is an instance of modern meanness, and, in large libraries, we can generally fix a date when long sets ceased o be bound in whole leather, and were continued in half binding. This style is useful for books that are not worth the expense of whole binding, but should be discouraged in the case of all works of intrinsic value; at all events, for private libraries. At one time, it was thought an improvement to cover the sides with cloth; but it has since been found that paper is better, because cloth is liable to get spoilt by the spilling of a liquid that would do but little injury to the paper.

In passing from the details of forwarding to those of finishing, we have to deal with those questions of tooling, colouring, and inlaid work to which I have already referred in my remarks on bookbinding as a fine art. I may, however, refer here to an ingenious contrivance of moveable stamps, proposed by Alexander Bain, which is described as follows:—"Four triangular blocks are employed, capable of being fixed in a simple adjustable frame, so as to suit any sized book. One adjustment with two actions of the press gives the four corners on both sides, and another adjustment with two actions of the press gives the middle ornament on both sides." For this invention the Society of Arts gave Mr. Bain, in 1828, the Silver Isis Medal and five pounds. I will now, in concluding the section relating to binding as a mechanical art, only make a few remarks on lettering.

Lettering was not common on English books until the latter end of the seventeenth century, but some French books were lettered at a much earlier period. A few—although very few—of Grolier's backs were lettered, and the Eves gained some fine effects on the backs of their books by the judicious use of the lettering as a part of the ornament. This is a difficult matter to speak upon with decision, because many old books have had letterings added, and many others have been re-backed. Lettering is a difficulty to the binder, and he should always be instructed as to what he ought to put upon the back. Dibdin mentions a bookbinder to the Cambridge University Library, who lettered one of Erasmus's editions of the New Testament, printed by Froben, which has an address from the printer to the reader, thus:—"Frobenius Lectori."

Good lettering is a sign of good work, and bad binders can seldom make their letters straight. Gold lettering is, of course, the one most in use, but black letters on yellow morocco and on vellum are very effective. Porson had a rage for caligraphy, and once offered to letter the backs of some of Richard Heber's vellum-bound classics. Heber told him he would not let him do that, but would be thankful if he would transcribe, into a copy of "Athenæus," his valuable emendations, which he did. Lettering should be short, and it is not always easy to reduce the point out of long title-pages.

A bookseller, named John Tupling, published a small pamphlet in 1854, entitled "Folious Appearances: a Consideration on our Ways of Lettering Books." He objected to good books being lettered outside with their real titles, and proposed what he considered an improved system. He would letter Spenser's Poetical Works "Shadowy Granite," or "Most Admired Disorder," or "A Sunshine in a Shady Place;" Cary's "Dante" he would call "Alien Corn," or, if bound as it should be, in three parts, he would letter the "Inferno"—"All the Damned;" the "Purgatory"—"More Mild;" and the "Paradise"—"Soft Ethereal Warmth;" Shakespeare's label he would leave blank, unless "The Deep Pulsations of the World," or "Hamlet" would do, for he asks "What is Shakespeare but

Hamlet?" Addison and Johnson were not favourite authors of Mr. Tupling, and he would pillory the "Rambler" as "Remainder Biscuit," and the "Spectator" as "Most Poor Matters." This is amusing, but not very practical.

Bookbinding as a Manufacture.

We now come to the last division of the subject in which Bookbinding is considered as a manufacture. Books have always been issued by the publishers in some sort of cheap binding, prepared in a wholesale manner. The material used has varied at different times, but up to the middle of the last century this was usually some common leather. Paper boards had a long period of popularity until they were displaced by cloth. I have seen the old-fashioned boards described as ugly, but I do not think that is a fair expression, as a well preserved book in this binding is very pleasant to the eye of the bibliophile, and its chief fault is want of durability. When prepared calico was first found to be useful for the binding of books, a mighty revolution was inaugurated, and it is upon this branch of the trade that the improvements in machinery have chiefly been brought to bear. About the year 1825 cloth binding was first introduced by Archibald Leighton, but it was several years before its value became generally known. In the "Bookbinders' Manual," 1829, to which I have already referred, there is a casual reference to the new style.

"Some boarded books, instead of a different coloured slip of paper, have their backs strengthened by a piece of fine canvas, which must be put on precisely as the paper above mentioned. There is another method of boarding greatly superior; the backs, instead of being sewn on bands, are sewn on strips of parchment, and the whole book is covered with canvas."

In the work entitled "Archibald Constable and his Literary Correspondence" (vol. 3, p. 310), a claim is made for "Constable's Miscellany," commenced in 1827,* as the first series, to be bound in cloth. About this time, some of the publications of the Society for the Diffusion of Useful Knowledge were issued in the same style, notably, the "Library of Entertaining Knowledge." These bindings were of the simplest character, consisting of a plain covering of glazed calico with a paper label. The labels were soon replaced by gold letterings, and the first book so treated is said to have been the edition of Byron's works in seventeen volumes duodecimo. The "Family Library," published by Murray, was bound in a still simpler style. The cloth used was of a light brown, and the title was printed on the cloth with printer's ink.

A great stride was made by Archibald Leighton when he was employed by Charles Knight to bind the "Penny Cyclopædia" and the "Penny Magazine." These were the first books issued in stamped cloth covers, and the cloth was stamped before being placed upon the boards. This practice was soon found to be unsatisfactory, from the stretching of the cloth and other disadvantages, and the block was then used after the boards had been covered. Leighton also prepared cloth in small pieces to imitate the morocco grain, but now the preparation of calico for binding purposes has become a large trade in itself; and it has been said that calico can be made to appear like almost every material other than what it is.

When ordinary stamping came to be used for the ornamentation of cloth binding, the adoption of specially prepared artistic designs was only a question of time. It is not necessary to point out how beautiful some of these designs are, because every one is familiar with them, suffice it to say that almost every style of treatment has been adopted, often with the happiest results. The multiplication of dyes during the last few years has greatly added to the resources of the cloth manufacturer, and the consequent improvement in the appearance of the books bound in this material. Unfortunately, carelessness in the sewing of the books has increased at the same rate as the beauty of the covers. The consequence is that books often tumble to pieces after reading, which might have lasted for years, had they been properly sewn. Cloth is a very durable material, and will outlast some leathers, but it has one formidable enemy, and that is wet. Spilt water and drops of rain will spoil a handsome cover in an instant.

As already remarked, cloth binding is entirely an English invention, and it is only of late years that foreigners have, to some extent, adopted it in place of their temporary paper covers. A slight but elegant covering for books has been found in vegetable parchment. This, which is much used in France, has been introduced into England by Messrs. Kegan Paul, and Co.

One special characteristic of wholesale cloth binding is what goes by the name of "case work," that is, the cover or case is made independent of the book, which is afterwards fastened into it. By this means, the covers can be produced in large numbers at a great saving in expense; and there is this further advantage, that much time is saved, when it is an object to issue a book almost immediately after the printing is finished. If due notice is given to a cloth binder with a large establishment, and the cases are prepared, an edition of a thousand copies of a book can be, and often is, bound within twenty-four hours. It is not necessary here to describe the various processes of wholesale bookbinding, or to enumerate the various machines used for the purpose, but I may be allowed to refer to a Report on the specimens of Bookbinding shown in the Exhibition of 1874, which was drawn up by Mr. H. Trueman Wood, secretary of the Society, and printed in our *Journal* for May 29th, 1874.

Various materials, such as buckram, and imitation leather like leatherette, feltine, and American leather cloth have been brought forward as rivals to cloth, but with only partial success. Great hopes were expressed that buckram would be found a good wearing material, but I believe that these hopes have been very generally belied.

There is one novelty which, I think, I should mention here, and that is the American patent wire sewing machine, which is now coming very much into use. It is useful for the fastening of newspapers and magazines, and has a neat appearance; but

* Cloth backs, with paper labels, were added to boarded books several years before this date, and I have a copy of Leigh Hunt's "Liberal," published in 1822-23, which is entirely covered in green glazed cloth, and has leather lettering pieces, but I cannot be sure that the binding is not a few years later than the date of publication. The claim made for "Constable's Miscellany" cannot be sustained, as I have three volumes of a book published in 1826 (Ryan's "Poetry and Poets") which is covered in plain red cloth with paper letterings.

the "extra binder" complains that the paper is damaged by the wire, and that he, therefore, is embarrassed when he comes to sew a book which has been so treated.

Practical Points connected with Binding.

I have now finished my observations on the history and the art of Bookbinding; but I do not like to break off without making a few remarks on some practical questions connected with the subject, which are of especial interest to the librarian. These, I suppose, I may put in some such form as this—1. What shall I bind? 2. How shall I bind? and 3. How shall I preserve what I have bound?

The first question need not detain us long, although it is one of considerable interest to the librarian, who has but limited funds at his disposal. Theoretically, everything worth keeping is worth binding, but the cost is often too great to allow the theory to be carried into practice. Many books are destroyed which might be preserved if the owners knew where to get them cheaply covered. Newspapers again would be very valuable if preserved in more libraries, but the cost of binding is excessive, owing to their great size. Some suggestions on the best mode of filing and preserving newspapers were thrown out by Mr. C. P. Russell, in a paper read before the Library Association (Report, 1878, p. 97).

2. "How to bind" is a question that covers a large number of different points. One of these is the treatment of pamphlets. The old plan was to bind as many as possible together, but the inconvenience of this is apparent; and in libraries, such as the British Museum, where funds are abundant, it is now the practice to bind each tract separately. Mr. Cornelius Walford, who has a large collection of pamphlets, follows the same plan, and manages to get a clear lettering on the back for the thinnest volume. I have here two specimens which Mr. Walford has lent me to illustrate two stages of his progress. The first, although very thin, has a clear lettering; the second shows the style now adopted; it has a strong leather back, and sides of manilla paper. The work is done at Northampton, is very inexpensive, and goes by the name of the Walford binding.

Some twenty-five years ago, an opinion was broached that colour should be used as an indication of style, and, in accordance with that view, specific colours were allocated to various classes of books. Thus, at the British Museum, historical books were bound in red, theology in blue, poetry in yellow, and natural history in green. This system had its advantages when the books were unclassified upon the shelves, but when all the books of one class were brought together, the general effect in a library was very patchy, and the advantages of distinctiveness were lost. On the whole, I do not think it advisable to go farther in this direction than what was proposed by Hartley Coleridge:—

"The binding of a book should always suit its complexion. Pages venerably yellow should not be cased in military morocco, but in sober brown Russia. Glossy, hot-pressed paper looks best in vellum..... The costume of a volume should always be in keeping with its subject and with the character of its author. How absurd to see the works of William Penn in flaming scarlet, and George Fox's journal in Bishop's purple! Theology should be solemnly gorgeous. History should be ornamental, after the antique or Gothic fashion. Works of science as plain as is consistent with dignity. Poetry, *simplex munditiis*."*

Variety of colour in the lettering pieces, and special selection of appropriate tools, have also been proposed for the same purpose of distinguishing the subject of a book. Three points occur to me as of importance to mention here:—1. That the date of the book should always be lettered on the back. 2. That where more than one volume, or part, is bound together, the division should be indicated by a difference of colour on the fore-edge. 3. That in the case of an index to several volumes of a set being bound up with one of the volumes, a special red lettering piece should be added to that volume.

I have already referred to the various leathers in use, but I may add here a word on Russia. This leather has very much gone out of use from its bad wearing qualities. If a Russia-bound book be placed on a shelf and left unused, it will soon powder away, but if it be constantly handled, it will last as long as morocco. We all know how well Russia purses wear, and the same may be said of books when they are nourished by the oil of the human hand. The dryness of the air soon impoverishes the leather, but if watched and oil added, before decay has gone too far, it may be saved for a time.

3. How to preserve the books under his care is a question of paramount importance for the librarian, and one that science should help him to answer. The two chief causes of injury to books, are damp and excessive dryness from a heated atmosphere. The latter was an evil that did not trouble our ancestors much, but they suffered from the former to a greater extent than we do. Robert Copeland, speaking of Chaucer, Lydgate, and Hawes, in his political prologue to Chaucer's Assembly of Foules, 1530, says—

"Many were the volumes that they made, more or lesse,
Theyr bokes ye lay up tyll that the lether *moules*;"

and Sir Thomas Bodley, in his directions to Dr. James, particularly orders that the books in his library shall be rubbed with clean cloths, as a precaution against mould and worms.

Handsomely bound books should always be kept in glass cases; and how well this preserves them may be seen any day in the Grenville library, where the books have a most superb effect behind the glass. It is most necessary, however, that the doors should be occasionally opened, or the moisture that is sure to settle on the inside of the glass will cause the works to become mouldy. Dry heat is the greatest enemy to books, which require proper ventilation as well as human beings. Gas is supposed to be particularly injurious; and, doubtless, the upper portion of an unventilated gas-lighted room is particularly obnoxious, so that books on shelves near the ceiling are likely to be specially injured. As to other positions, it is not clear that the heat emitted by gas is more destructive than the same amount of impure air from other systems of lighting; in fact, the library in which the books were in the worst state of powdery decay I have seen ever, was placed in rooms lighted by lamps and candles. This question, although it has long been debated, remains still unsettled.

* "Biographia Borealis," 1833, p. 537.

Rats and mice, book-worms and cockroaches, have done great damage in libraries, and it is often with the greatest difficulty that they are got rid of. Mr. Walford was much troubled by cockroaches, and he found that they attacked, almost exclusively, the books bound in crimson cloth.*

Here I end, and I hope no one will think that much unnecessary fuss has been made respecting the mere outsides of books. As the clothing of the human being is something more than a protection from cold or heat, so the clothing of a book should be something more than a mere preserver. Every one who appreciates a good book, will wish to honour it with the best binding he can afford, and thus show without words his high opinion of his loved companion.

Appendix.

The history of Bookbinding has still to be written, but much material has, at different times, been collected for the purpose, and I will, without pretending to any kind of completeness, notice some few of the contributions on the subject that have come under my notice. John Bagford, the bookseller, who died in the early part of the last century, made a collection of specimens of bindings (mostly of stamped calf), which he stripped off the books themselves. These are in the Manuscript Department of the British Museum, where there are also a large number of fine specimens of early bindings, which have been specially catalogued in the classed catalogue of manuscripts under the division of drawings. Dibdin's "Bibliographical Decameron," 1817, contains much information about Binding and Binders, but Mr. Charles Tuckett was one of the first to make arrangements for the publication of fac-similes of fine bindings, and, in 1846, he issued the first part of a work, entitled "Specimens of Ancient and Modern Binding, selected from the Library of the British Museum, with an Introduction containing the History of Bookbinding from the Earliest Period to the Present Time." The book did not meet with sufficient recognition, and eight plates only were published. The history of Bookbinding, therefore, never saw the light. About this time Mr. Joseph Cundall read a paper before the Society of Arts on "Decorative Art Applied to Bookbinding," which was printed in the Transactions, and illustrated with some fine specimens. Several years after (1862), Mr. Libri published his "Monuments Inédits ou peu connus," which contains coloured lithographic representations of a large and very fine collection of historical bookbindings.

About the same time as Mr. Libri's work appeared in London, a magnificent series of engravings of choice bindings was being issued periodically by MM. Techener, under the title of "Histoire de la Bibliophilie." This was left incomplete, but it contains a superb series of specimens, and its only fault is that the engravings are too good as works of art themselves to give a thoroughly accurate idea of the books.

In 1864, was published "L'Art de la Reliure en France aux derniers siècles," by Edouard Fournier; in 1869, the "Album de Reliure," by the Bibliophile Julien, and in 1879 appeared "La Reliure Ancienne et Moderne," with an introduction by Gustave Brunet.

In Germany, a little book has appeared, entitled "Zwölf Buchbinder, von Schmidt-Weissenfels," and, in 1878, a large work, consisting of artistic designs for binding, was commenced at Stuttgart, entitled "Modérne Bucheinbände, von Gustav Fritzsche," but, not having sufficient support, it ceased with the fourth number.

The most marvellous reproductions of fine book-covers are, however, to be seen in the *Bulletin* of Messrs. Morgand and Fatout, booksellers in Paris, to whom I am indebted for two of the plates illustrating this paper. This catalogue contains several cuts in black and white, and also many coloured photo-lithographs of surprising excellence. One of these, inserted opposite to page 714 may be looked at until the eye fancies it sees the book itself. One of the latest books on the subject of Bookbinding is a treatise by Mr. J. W. Zaehnsdorf, published last year. Mr. Zaehnsdorf has kindly lent me two blocks out of his book to illustrate this paper.

* "On Binding of Books for Public and Private Libraries." Transactions of the Conference of Libraries, 1877, p. 116.

DISCUSSION.

The Chairman said he trusted that all present were lovers of books, and liked to see them clothed in an ornamental and appropriate style. There were one or two points which Mr. Wheatley had passed over rather lightly, on which, possibly, some gentlemen present might offer some remarks. He might mention one great amateur of binding, who seemed to have escaped Mr. Wheatley's attention—which he might easily have done, as his books had only lately come into vogue—a certain Baron de Longepierre, who lived towards the end of the 17th and beginning of the 18th century. He was a literary man, and wrote several dramas, which were all of them damned until he fell back on the stock subject of Medea, in which he was successful. He was so elated with his success that he determined to have all his books ornamented with the golden fleece. They were most charmingly bound in morocco of various colours, and in the centre and corners of each cover he had a golden fleece stamped. These books had lately become quite the rage, and a small specimen would sell for £150 to £200. With reference to ancient bookbinding, a subject which did not seem very well known, there was a book published by Schwarzius, being a collection of dissertations delivered between 1705 and 1716, at Altdorf; which was afterwards re-edited and published by Dr. Lenschner, at Leipsic, in 1756. Any one interested in this branch of the subject, might refer to it with confidence, and would find in it a perfect mine of learning.

Mr. Weale said he had paid great attention to early leather bindings, and would venture to point out one or two inaccuracies in the paper. It could hardly be said that Germany had produced the most remarkable stamped leather bindings, for he claimed that honour for Holland and Belgium, the earliest he had met with dating from the beginning of the 14th century. The earliest with names dated from the end of the 14th century; and at that time Utrecht had several binders who produced most remarkable works. Binders from Utrecht afterwards settled in the Low Countries—at Bruges, Cambray, and other places; and from the archives, he had been able to identify some books, and trace the marks of some of these artists. He also found that when these men died, it was the practice to sell their tools, and in this way the fact that at Basle and other places the same designs were used, was accounted for. No mention had been made of the style called *cuir-*

bouilli, a specialty of Nuremberg and Bruges, which was remarkably light, boards not being used, and very durable. He had a photograph of some specimens in the Germanic Museum at Nuremberg, and the Imperial collection at Vienna. He would also remark that the statement that the names of the French binders were very little known could not be applied to the 15th century; the binders of Cambray, Lisle, Paris, Amiens, Arras, and Valenciennes could be obtained from the wardrobe accounts of the Dukes of Burgundy, and by the same means the marks of many of these binders could be identified. At a later date, Laurin had his own peculiar style, somewhat akin to Grolier, but, he thought, superior, being rather more simple. As regards Spanish bindings, he considered those of Saragossa and Seville remarkable for their great beauty; they were very scarce, but he could show a rubbing of a Saragossa binding, of 1511, remarkable for its elegance. Instances of a similar style occurred in Italy, and led to the belief that the art was introduced into Spain from that country. There could be no doubt that the reason early books were not lettered on the back was because it was usual to turn the fronts outwards; and it was an interesting question at what date the charge in this habit took place. He once came across a picture dated in 1676, of the interior of a library, in which the books stood edge outwards, and he should like to know if this was the latest known instance. Much light might be thrown on such questions by an examination of pictures. There was little doubt that Caxton obtained his notions of bookbinding where he learned printing, at Bruges, and the dragon and rose which he used were extremely like the marks used by the binder of that city, who worked for Margaret of York.

Mr. Christopher Cooke said there were references to Roger Payne in "Nichols' Literary Anecdotes," vol. 3, and in the "Gentleman's Magazine," for December, 1797. Mr. Cundall had also referred to him in a lecture given before that Society in 1847, wherein he spoke of him as being without either a rival or successor. In the *Archeological Journal*, vol. 18, and in the Transactions of the Archeological Society for 1860, there were some very curious books mentioned as being preserved in the library at Westminster Abbey. He should like to know if there was any truth in the assertion that the electric light was injurious to books.

The Chairman remarked that there had been no damage done to the books in the British Museum by the electric light.

Mr. Cornelius Walford said he had gone through nearly all the phases of biblomania with regard to bookbinding. First of all he looked upon it as a fine art, but he found it very expensive in this point of view, and came to the conclusion that it ought to be a useful art; but when one had a large library, it became very difficult to arrange all the books so as to find them when one wanted them. It was in that sense that his attention was first directed to bindings. Like many others, he used to bind a number of pamphlets together, and it was necessary then to maintain, as far as possible, the individuality of the pamphlets. For that purpose the edges should not be cut, so that when the volume was opened the different pamphlets appeared separate. But then he found that when you thought you had made a complete collection on one subject, there were always some left out, and eventually he had to adopt the plan of binding each one separately. Then came the difficulty of expense. He liked a book to look handsome, and to feel like a work of art, but to bind them in the style like one he had in his hand, cost 10s. 6d. each, which came rather heavy when there were a large number. He had, therefore, tried one style after another, until he adopted the one referred to in the paper, which cost about 1s. 4d., by having a number done at one time. He found black leather bring up the lettering better than anything else. Coloured bindings, which he had tried, was in some cases a failure, though it had only been carried to a certain length, as in binding Parliamentary books light blue, books on Ireland green, and so on; but binding in colours by subjects, was in his opinion, a mistake. He advised those who had not done so, to take an opportunity of inspecting Archbishop Williams's library, at Westminster, but they must take care not to get locked in, as happened to one gentleman, who was shut in and forgotten. Vellum had many advantages, one of which was that the contents of the volume could be easily written on the back. There were some splendid specimens of gilding inside the covers in the Advocates' Library at Edinburgh, and also in the Bodleian Library, so that the only wonder was where the money could have come from to pay for such luxury. For practical purposes, he thought such expensive binding was a mistake, as it made the books only fit to be looked at, instead of being used.

The Chairman thought it might interest the meeting to know the titles of some of Mr. Walford's books, which he had so carefully bound; one was—"Two Godly and profitable sermons, earnestly inveighing against the sins of this land in general, and, in particular, against the sins of this City of London; preached in the City of London by Thomas Hopkins, &c., 1615." Another was against usury, having a woodcut on the title page, with a label proceeding from the mouth of the usurer, "I say, I will have all; both use and principall." Another on astrology; and another on life assurance, on which he believed Mr. Walford was a great authority.

Mr. Walford observed that he had a large collection of sermons, but he did not buy them to read, but to illustrate different events in English history. On the Fire of London there were 600 or 700 sermons preached, one man alone having preached 300. He had looked through some of these sermons, but never found a single spark of light or intellect in any of them, and, as a rule, they did not even contain any information on the subject they were supposed to illustrate.

Mr. Bradshaw (Cambridge) had some doubt about there being any specimens of Caxton's time in limp vellum; those referred to by Mr. Blades had probably been re-bound when the boards got worm eaten. What he should like to see above everything, and perhaps the Chairman might do something in that way, would be a collection of specimens historically arranged, showing the various styles at the different dates. Such a thing might be arranged in the British Museum, or perhaps even better at one of the Universities. For instance, at the University Library, Cambridge, they had books which were given them in 1424. Most of the valuable books had been re-bound, but some remained in their original condition; and he wanted to be able, when he took a book in his hand, to tell almost the decade in which it was bound. He had given some attention to the early English binders, and had been much assisted by the fragments used in the binding. He understood now that care was taken in the Museum, when such fragments were taken from a book re-bound, to state what book they came from; but formerly this precaution was neglected, and even now it was so in many places. He had recovered specimens of Caxton and De Worde, simply from finding printers' waste in the binding. He found, in one book, a fragment, printed by Lettou, the first printer of the City of London; and on going to Oxford, and looking at some other books by the printer, he recognised the same tooling at once. With very little difficulty, he could trace the change from 1480 to 1490 to 1500, and then a totally different style again in 1510 and 1520. If an exhibition could be formed, showing the sequence of patterns and style, it would be very useful; because, in binding books, if you imitated at all, it was very desirable to imitate the right style of the period. He only knew one man who had done anything in this way, and that

was the librarian at Ghent. It was also very important that more attention should be paid to the forwarding; many binders looked upon books merely as pieces of furniture, with a magnificent outside. He remembered a specimen of Paris binding in the British Museum, which showed the falsification sometimes resorted to. It was one of those beautiful Bruges books which were exceedingly costly, in which missing leaves had been supplied. The binder, having an idea that the old printers always put a blank at the beginning, when there was no title—the fact being that this particular printer never did—forged a blank leaf, of the same paper as the body of the book, and even put a "set-off" on it to make it look real. On examining it with a glass, however, it was seen to be a set-off from one of the fac-simile leaves in the book, and not from the first page at all. The new wire system of binding was very troublesome when a book had to be re-bound. No doubt good binding was expensive, but no one would grudge the money for good binding if it could be got.

Mr. George Simpson, as a master bookbinder of some standing, could not sit still to hear it said that there were few bookbinders in London who could honestly forward a book. There were brethren of his in the room who loved their trade, as the artists of old loved theirs, who carefully watched every stage in the process up to the finishing, and were determined to be in no point behind the best of their predecessors. When anyone complained of bookbinders not turning out strong work, they should go to their masters and ask how they paid for it. Modern bookbinding, with its gaudy covers, was frequently done merely for the purpose of selling, and the sooner it fell to pieces, so much the better for the publisher, who grudged the binder the farthing or half-farthing required to sew it strongly enough to bear once or twice reading. As a bookbinder, he loved his trade, and in his own house he only cared to handle books which were well bound. He would not use a hymn-book badly bound, any more than any gentleman who had made the art a study. He would leave the artistic side of the question to those who understood it better, but he must protest against the statement that, as a mechanical art, bookbinding was dead and gone.

Mr. Bernard Quaritch said he had an immense collection of old bindings, and knew something about them. Bindings might be divided into two main divisions—those which already existed, and those which collectors wished to have executed. As to the past, no doubt bindings were produced chiefly for very rich men, such as kings and nobles, and ecclesiastical corporations, and from the earliest times the cost of the art had been very considerable. That was the reason why old bindings, generally speaking, were infinitely superior to those of the present day; some of them cost hundreds of pounds of our money. The French binding from Grolier's time had been very good, but all the great collectors paid very handsomely for their work, and that was why it survived now. If collectors of the present day were equally liberal, no doubt artists would be found in England to equal anything in the past. The reason why France had been so famous in this matter was, that the French nobles were a fine body of men, of artistic taste, such as existed nowhere in Europe. That was why their books commanded such a price now in France, where book-collecting was carried on much more extensively than in England, to say nothing of Germany, where they only read them. There were still English artists, though they had not been mentioned; such as Riviere, who, he was sure, lost money by some of his work; and Zaehnsdorf; and, above all, Francis Bedford, whom he considered the greatest artist in bookbinding that England, or any other country, had ever produced. He could show specimens of his work, which surpassed any French binding he had ever seen, except in age. Bedford was formerly with Lewis, who was the founder of the style which Riviere and Bedford now repeated. Riviere's style was more ornamental, but Bedford's was more chaste. His work ought to be examined from the very beginning to understand its excellence. In the first place, he paid higher wages than anyone in London, and the result was that every part of the work was done with a care and accuracy which other men could not afford. The way in which he bound old books was marvellous. If they saw old books in the state in which they came from a sale, they would hardly believe it possible to turn such a wreck into a handsome book. Mr. Bedford first pulled the book to pieces, each leaf being treated separately; it was then dipped into size and water, washed and dried; then mended, and the art of mending was one of extreme delicacy; there were not three people in England who could mend a book properly. Then there would be, perhaps, a word or a letter missing here and there, which the fac-simileist had to supply; then the pages were brought into line, some having a bit put on the top and some on the bottom, which again was a most difficult and delicate operation; then it was carefully stitched and covered, and, lastly, came the gilding and lettering. On this Mr. Bedford bestowed an immense amount of care, which had to be paid for. For the last three or four years he had been ill, and had actually examined the books and superintended his workmen from a sick bed. He (Mr. Quaritch) had often said to him, "The world can easily spare me, but it cannot spare a man like you;" and he thought it only right on such an occasion that some honour should be paid to a man whom he considered the first bookbinder, not only in England, but in Europe.

Mr. Weale said they heard a great deal about the penuriousness of amateurs now-a-days, but there was one fact which could not be disputed, and could be proved by an examination of Flemish and Dutch books and church accounts, that the ordinary bindings in stamped calf with gilt edges, in old times, never exceeded half the price of the book itself, and generally did not exceed one third. Now, the difficulty was to get a book bound for anything less than it cost, and these old books were solid. He had breviaries in his possession, which he could prove to have been in use for 20 or 30 years, which were perfect, but he never found anyone now who could bind a prayer-book which would last ten years if used every day.

Mr. Quaritch said the common run of bindings did not interest him at all; his remarks referred to books of the highest intrinsic value commercially. A book worth £10 or £20 certainly deserved an equal expenditure for binding. Indeed, an old book, much dilapidated, would cost as much as that for mending. He did not think the public had any right to find fault with bookbinders' charges.

The Chairman remarked that bookbinding was done cheaply in England, as compared with France. He remembered, some 20 years ago, a gentleman calling at the British Museum to see some of the bookbinding; he looked at several specimens, but did not seem to think very much of them, and at last he took some out of his pocket, which he had had bound in Paris, as he said very cheaply, because he knew the binder. They were certainly very nicely bound, and on being asked what the cost was, he said he had them done very cheaply, and only paid £20 for a very small one; an old French poem, of no particular value. He expatiated on the advantage of being personally acquainted with the binder, not only in regard to price, but also as preventing delay, for he said he had not to wait more than three months for that one, which was of importance to him, as he was just going to America. He was an Irishman, and he lived alternately in Paris, and amongst the North American Indians,

amongst savages, and in the highest degree of refinement.

Mr. Quaritch did not think £20 too much to pay for a specimen of Trautz-Bauzonnet. That artist did nearly all the work himself, and, consequently, could not do very much, and required a high price. Mr. Turner had some books bound by him, and had to wait a long time, and Baron James Rothschild paid any price for his bindings. Capet's work was nearly as good, and he only charged from £4 to £10 for a small volume, such as the Chairman had referred to. He recommended gentlemen who had good books to take them to a good binder, and then they would always fetch a good price if they came to be sold.

The Chairman then proposed a vote of thanks to Mr. Wheatley, which was seconded by Mr. Walford.

Mr. Wheatley, in reply, said that there were several points raised in the discussion which he should have liked to have alluded to, but time would not admit of his doing so. He expressed his thanks for the kind manner with which his paper had been received, and said it was a particular gratification to have an opportunity of thanking those who had so kindly assisted him. He felt sure that the meeting, when they looked at the beautiful collection of bindings brought together for their inspection, would agree with him how much they were indebted to those who had so kindly lent their treasures. Thanks were more especially due to Sir Philip Cunliffe Owen for the fine collection of books from the South Kensington Museum; to Mr. R. S. Turner, for some most important examples of celebrated collections; to Dr. Birdwood, for some Indian-bound books from the India-office; to Mr. Bain, for two costly volumes; to Messrs. Sotheran and Company for some rich old bindings; to Messrs. J. and J. Leighton, for some fine bindings and illustrative specimens; to Mr. Riviere, for some particularly handsome examples of his binding; and to Mr. Zaehnsdorf, both for specimens of his own skill, and for some grand old bindings. Also to Mr. Cundall, for some excellent photographs; and to Mr. John Leighton, for rubbings and various specimens. He also wished to thank the Chairman, and Mr. Fletcher, of the British Museum for their kind assistance in pointing out to him some of the Bibliopegistic treasures of the British Museum.

CATALOGUE OF THE SPECIMENS OF BINDING LENT FOR EXHIBITION.

German.

Flores Musice. Quarto. Wooden boards; ornamental stamped vellum back. Lent by Mr. Zaehnsdorf.

Strabo. 1549. Elaborate stamped brown calf, on wooden boards. Lent by Mr. Zaehnsdorf.

Strauch, Predigten. 1683. Folio. Brown calf, with ornamental brass bosses, corners, and clasps. Lent by Mr. Zaehnsdorf.

The following three books, and fifteen other specimens of fine bindings, described in the following list, were lent by Sir Philip Cunliffe Owen, K.C.M.G., C.B., from the South Kensington Museum:—

Lutheran Bible, printed at Jena, 1564. Binding covered with gold tooling, a coat of arms emblazoned on either side; the edges gilt and *gauffré*, with birds and flowers, and the same coat of arms. Dated 1583.

Mar. Fabii Quintiliani Declamationes. Lyons, 1530. In binding of dark brown calf; on each side a medallion of Charles V., his shield, device, and motto in blind tooling. About 1530-40.

Flemish.

Officium Beatæ Mariæ Virginis. Antwerp, 1625. In binding of olive morocco; the back and sides ornamented with gilt tooling, fastened with silver clasps.

Spanish.

Maria de Zayas y Sotomayor. Novelas. 1659. 4to. Olive morocco, with the arms of President de Menars subsequently stamped on the sides. Lent by Mr. R. S. Turner.

Italian.

In manuscript, "Questio de distinctione Attributorum Dei." In red calf binding, with gold tooling; shield of arms in colours on the centre of each side, the edges gilt and *gauffré*. 16th century.

Arme (Andrea dall') Emblemi e Sonetti. Oblong small quarto. In the original binding, the sides covered with gold tooling; "fan" pattern in corners. 16th century.

Manuscript, on vellum, in Italian, relating to the Riario family, in morocco leather binding, executed at Rome, with the arms of a Cardinal as the centre ornament on either side. Date of MS, 1683.

Marlyrologium Romanum. Venice, 1673. Bound in crimson morocco, with gilt tooling, "fan" pattern in corners; gilt metal clasps. *Venetian.*

Backgammon Board, covered with old red morocco leather in the form of a book cover, stamped with the Medici arms on each side; "fan" pattern in corners.

Poesie di Lodovico Casale. 8vo. Rome, 1670. Bound in crimson morocco, with gold tooling. On each side are the arms of Pope Clement X. Dated 1670.

The above six volumes from South Kensington Museum.

Petra, Commentaria, 1693. Folio. Red morroco, with elaborate floreated design in gold on sides, and arms of a Pope. Lent by Messrs. Sotheran and Co.

Ansaldus de Ansaldis, Decisiones, 1710. Folio. Red morocco, fully gilt, with the fan patterns in the corners, and the arms of Pope Clement, to whom the book is dedicated, in the centre. Lent by Messrs. Sotheran and Co.

French.

Macrobius. 1501. Folio. Brown calf, ornamented on the side with interlaced work in gold and black. From the Grolier collection, with the inscription, "Io. Grolierii et Amicorum." Lent by Mr. R. S. Turner.

Themistii Opera. 1534. Folio. Brown morocco. From the collection of Henry II. and Diana of Poictiers, with the Royal arms and H., surmounted with a crown and Diana's monogram and device, the crescent moon, in gilt, on the side. Lent by Mr. R. S. Turner.

Citolini, La Tipocosmia. 1561. Vellum gilt, with the arms of De Thou alone, when he was bachelor, on the side. Lent by Mr. R. S. Turner.

Rodriguez Bulla de la Sanata Cruzada. 1592. Brown sheep, with the arms of De Thou, and his first wife, Marie, on the side, and their united monogram. Lent by Mr. R. S. Turner.

Summonte, Historia di Napoli. 1640. 4to. Red morocco, with medallions on sides containing two shields of arms, and De Thou's monogram on back. Lent by Mr. Zaehnsdorf.

Conringius, de Sanguine. 1646. 12mo. *Veau fauve*, with the double shield of arms and monogram as used by the President De Thou's son. Lent by the Royal Medical and Chirurgical Society.

Gyllius, de Bosporo Thracio. 1661. 8vo. Red morocco, with shield of arms on the side, and monogram on the back, as used by the younger De Thou. Lent by Mr. B. R. Wheatley.

Psalmorum Davidis translatio. R. Stephens, 1556. Grolier binding in morocco of different colours, with gilt leaves, *gauffré*. From South Kensington Museum.

Missale Romanum. Antwerp, 1577. In brown calf binding, with gilt tooling and coloured strap work in the Grolier style. From South Kensington Museum.

L. Psalmorum Liber. Lyons, 1542. In brown calf binding in the Grolier style, with strap work of coloured leather, the edges gilt and stamped. From South Kensington Museum.

L'Office de la Vierge Marie. Paris, 1596. 12mo. Bound in olive morocco, tooled and gilt with devices of Marguerite de Valois. From South Kensington Museum.

Du Bé. Medicina Theoretica. 1671. 12mo. Red morocco, covered with *fleur-de-lys*. Lent by the Royal Medical and Chirurgical Society.

Plinii Historia Naturalis. 1635. Red morocco, by Le Gascon, from the Library of Kenelm Digby, with his arms quartered with those of his wife, Venetia. Lent by Mr. R. S. Turner.

From South Kensington Museum:—

Pretiosa Margarita. *Aldus*, 1546. Sm. 8vo. Red morocco, with gilt floral border. Bound by De Rome. From the MacCarthy collection. Lent by the Royal Medical and Chirurgical Society.

Necker, Les Finances de la France. 1874. 8vo. Red morocco, by De Rome. Lent by Mr. B. R. Wheatley.

Book Cover. Vellum, diapered with *fleurs-de-lys*, alternating with crowned L's; probably the binding of a book belonging to Louis XIII. About 1630.

English.

Old Bindings.

Manuscript, on vellum, of the early part of the 15th century, in wooden boards with vellum back, from the Abbey of Kenilworth. Lent by Mr. A. Cowper Ranyard.

Cope, Meditacion on the Psalmes. 1547. 4to. Brown calf, fully gilt, with Royal arms on the side, from the library of James I. [Similar style as that represented in Fig. 9.] Lent by Mr. R. S. Turner.

The Book of Common Prayer. Folio. London, 1704. Bound in black calf, gilt, with the Royal shield of Queen Anne, and crowned monograms and devices. Lent from South Kensington Museum.

Gentleman's Religion. 12mo. London, 1703. Bound in citron morocco, inlaid with coloured leather, and mounted with gold tooling, *doublé*. *English*. From South Kensington Museum.

Rider's British Merlin. 12mo. Highly ornamental red morocco. The gilt tooling changed each year, the later ones less artistic than the earlier. 1704, lent by Mr. Zaehnsdorf; 1733, lent by Mr. B. R. Wheatley; 1752, lent by Mr. Danby P. Fry; 1799 and 1804, belonging to H. B. W.

Court and City Register for 1766. 12mo. Red morocco, with ornamental gilding on the sides and back. Lent by Mr. Zaehnsdorf.

College of Physicians, Statutes in MS. 1752. 4to. Dark blue morocco, with gold tooling on the side. Lent by the Royal Medical and Chirurgical Society.

Weston's Art of Short Hand. London, 1727. Small 4to, printed from copper-plates; bound in blue morocco, tooled and gilt, in the cottage style. Lent from South Kensington Museum.

Skeeler's Sermons. 1772. Red morocco, in Harleian style. Belonging to H. B. W.

Bible in Spanish. 1566. 12mo., calf. 2 vols, in twin binding. Lent by Messrs. Leighton.

Churchill's Poems. 1763. 4to. Red morocco, inlaid with green, and fully gilt. From the library of John Wilkes. Lent by Mr. R. S. Turner.

Grammont Memoirs. 1772. Light brown calf. Horace Walpole's copy, with his arms on the sides. Lent by Messrs. Sotheran and Co.

Corneille, Chef d'Œuvres, Oxford. 1746. 8vo. Blue morocco. By Roger Payne. A very fine specimen of the artist, with his bill inside. "Bound in the very best manner, the back lined with thin morocco. Fine drawing paper, double filleted, and morocco joints in ye insides. The back finished with small tools, and very correctly lettered in workmanship. The outsides finished with ornamental covers or small tool work, gold filleted panes, and laurel branch corners; very neat and strong boards—0 14 0." Lent by Mr. R. S. Turner.

Lysias. Orationes. 1740. Russia gilt, with red leather lining, by Roger Payne. Lent by Mr. B. R. Wheatley.

Aikin's Memoirs of Medicine. 8vo., 1780. Stained calf, by Kalthoeber. Lent by the Royal Medical and Chirurgical Society.

Rogers's Italy. 8mo. Green morocco, with gilt back and ornamental border on the sides, by Charles Lewis. Lent by Mr. B. R. Wheatley.

Blank Album. 4to. Purple morocco, with gilt tooling on back and sides, by Mackenzie. Lent by Mr. B. R. Wheatley.

Campbell's Gertrude of Wyoming. 1814. 12mo. Green morocco, with landscape painted on the leaves. Lent by Mr. Zaehnsdorf.

Bindings by Living Artists.

The following books were lent by Messrs. J. and J. Leighton, all being bound by them:—

Dante, Inferno. Folio. Black morocco, inlaid with coloured leather, representing the serpent with the apple, surrounded by flames of fire.

Lyra Germanica. 1861. Sq. 8vo. Blue morocco, with emblematical tooling, in case of green Spanish morocco, which is not now procurable.

Moore's Poetical Works. 1855. Sm. 8vo. Green morocco, elaborately gilt.

Shakespeare. 1849. Royal 8vo. Green Levant morocco, with painting on the fore-edge, representing Shakespeare reading to Queen Elizabeth, gilt over.

Officium Immaculate Conceptionis. 1859. Royal 8vo. Blue morocco, with emblematical gilding on the side.

Portraits des Rois de France. Blue morocco, diapered with *fleur-de-lys* in bold tooling.

Series of seven books, showing the various stages in the process of forwarding.

Bible, with monastic pouch and cords to suspend it from the girdle.

Two cases of specimens of ornamental silk head bands.

A vellum cover, tooled in imitation of early 17th century Dutch binding.

The two following books, bound by Mr. Riviere, were lent by Mr. Bain:—

Domesday Book. Folio. Bound in Mogador morocco. Illuminated after an embroidered design by the late Godfrey Sykes, of the South Kensington Museum. In the centre is the Conqueror enthroned; above is the invasion; below, his numbering of the people and inventory of their goods.

Dante. Folio. Bound in Mogador morocco, with illuminated details in the Renaissance style.

The four following books, also bound by Mr. Riviere, were lent by him:—

Prince Rhodocanakis. Imperial Constantinian Order of St. George, 1870. Folio. Brown morocco, richly gilt in the Grolier style.

Life of Prince Rhodocannakis. Folio. Brown morocco, with flowing design in gilt tooling.

Report of the Grand Lodge of Greece. 1872. Folio. Dark purple morocco, blind tooling, after the manner of the old German stamped leather.

Loftie's Latin year. 1873. 12mo. Yellow morocco, ornamented with interlaced work, and flowing leaves, richly gilt.

The following books were lent by Mr. Zaehnsdorf, all being of his own binding:—

Laforge, La Vierge. 1864. 4to. Purple morocco, with gilt border, after the name of De Rome.

Booth's Reprint of the First Folio of Shakespeare. 4to. green morocco, richly gilt, in the imitation of the early French style.

Margry, Les Navigations Françaises, 1867. 8vo. Green morocco, richly gilt, in imitation of Le Gascon.

Troupe de Voltaire, 1861. 8vo. Red morocco, richly gilt, in imitation of Le Gascon,

King's Antique Gems, 1866. 8vo. Spotted calf, imitation of old English style, with solid gilt ornament in centre.

Female Characters of Goethe. 1868. 8vo. Green morocco, in imitation of Roger Payne.

Evvres de Lovize Labe. 1862. 8vo. Green morocco, inlaid with red and yellow. Fully gilt.

Goethe, Hermann und Dorothea. 1869. Royal 8vo. Orange morocco, inlaid and gilt.

Pernette Du Guillet, Rymes. 1864. Blue morocco, diapered with *fleurs-de-lys*.

Prayer Book. 12mo. Brown morocco; painted ornaments on side and back.

La Sainte Bible. Folio. Bound in brown morocco border, and cross in centre on side, and back inlaid in colours; *finished*. The same, *unfinished*, before the gold tooling was added, which shows a considerable difference in the contrast of colours.

Yule's Book of Marco Polo, 1874. 2 vols. 8vo., brown morocco, with floral design and arms on the side, designed by Dr. Birdwood, bound by Zaehnsdorf. The same in vellum, with the floral design in gold and colour, and arms in gold. Lent by Messrs. Sotheran and Co.

Collection of boards, showing the successive use of wood, paste-board, and mill-boards. Lent by Mr. Zaehnsdorf.

Irish.

Gentleman's and Citizen's Almanac. Dublin, 1779. Bound for the Lord Lieutenant, in red morocco leather, gilt. *Irish*. Lent from the South Kensington Museum.

Indian.

Four volumes, bound in leather, fully gilt (Indian binding). Two volumes, bound in leather, with blind tooling (Indian binding). Lent by Dr. Birdwood.

Gulistan. Printed at Lahore. Leather binding, with ornaments in gold and colour, and painted edges. Lent by Dr. Birdwood.

Abyssinian.

King Theodore's Bible. 8vo. Abyssinian leather binding. Lent by Messrs. Sotheran and Co.

Series of Photographs of fine specimens of Bookbinding. Lent by Mr. Joseph Cundall.

Rubbings, drawings, &c., from bindings and various covers from old books. Lent by Mr. John Leighton.

DESCRIPTION OF ENGRAVINGS.

Fig. 1.—French Binding, from Grolier's collection.

Fig. 2.—French Binding, from the collection of the President De Thou.

Fig. 3.—Work of the French binder, Le Gascon, from a copy of the Paris "Anacreon," 1639, in the possession of Messrs. Morgand and Fatout, of Paris.

Fig. 4.—French Binding, with the initial and monogram of Louis XIII., and his Queen, Anne of Austria. Taken from a copy of "Les Diverses Leçons de Pierre Messie," 1572, in the possession of Messrs. Morgand and Fatout, Paris.

Fig. 5.—English Binding of the 18th century, from a copy of Rider's "British Merlin."

Fig. 6.—English Binding of the 16th century. From the Library of Edward VI., now in the British Museum.

Fig. 7.—English Binding of the 16th century. From the Library of Queen Elizabeth, with the badge of her mother, Anne Boleyn, as borne by her before she came to the throne.

Fig. 8.—English Binding of the 16th century. From a volume formerly belonging to Robert Dudley, Earl of Leicester.

Fig. 9.—English Binding of the 17th century, in the style adopted by James I., with the Prince of Wales's feathers and initials of Henry Prince of Wales, in place of the royal arms now in the British Museum.

Fig. 10.—English Binding of the 17th century. From the collection of Henry Prince of Wales, now in the British Museum.

Fig. 11.—English Binding of the 17th century. From the collection of Henry Prince of Wales, now in the British Museum.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1880, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially, by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For.Memb.R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labour."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

The Council invite members of the Society to forward to the Secretary, on or before the 24th of April, the names of such men of high distinction as they may think worthy of this honour.

MISCELLANEOUS.

THE CULTIVATION OF THE SORGHUM PLANT, AND ITS MANUFACTURE INTO SUGAR IN THE UNITED STATES.

Many attempts have been recently made, in the United States, to produce good results from certain vegetables for the production of sugar, in one of which her Majesty's Secretary of Legation at Washington points out a remarkable advance has been made in the extraction of sugar from the sorghum plant. In competition with beet, the manufacture of sugar from sorghum may, perhaps, stand but a poor chance, yet there is one advantage in its favour, that it requires less machinery and less capital, as, to make sugar from the beet, expensive works are necessary. The sorghum and the beet differ materially; the same process for the extraction of sugar from the latter not being applicable to the extraction of sugar from the former and Indian corn. The sorghum contains ordinarily from 1½ to 2 per cent. more sugar than the juice of Indian corn, and corn more than the beet.

From analyses made of sorghum juices, they have shown a great range of variability as to the true sugar which they contained. The normal amount, 10 to 13 per cent., has been found by most chemists, but occasionally not more than 4 to 5 per cent by others; the mode of reconciling this difference exists in the fact that it is necessary to cut the cane very soon after it has arrived at the proper point of maturity, and it is also necessary to work it up within a limited time after cutting, as there is a process of deterioration which commences at the base of the stalk, and continues through it. The Commissioner of Agriculture, from repeated experiments made from Texas to Minnesota, arrives at the following conclusions as to the importance of sorghum, as a crop and as a manufacture. The average production of sorghum from an acre of land, that will produce 40 bushels of corn, he puts at 165 gallons of syrup, weighing 12 lbs. to the gallon, or 2,000 lbs. of syrup to the acre. This syrup, under the process which is now in use, and easy of application, will divide into 1,000 lbs. of sugar and 1,000 lbs. of syrup. The producer of the cane, if he has the machinery, can manufacture this for himself. The sorghum cane is also prolific in its seed, which is as valuable as oats or corn for domestic animals, yielding from 15 to 30 bushels an acre. The manner of cultivation and process of manufacture are as follows:—The sorghum ground is broken up for planting in just the same way as for common corn, prepared in a similar manner, and at the same season of the year. It requires about two quarts of seed to plant an acre properly in drills 4½ feet broad. It comes up in a slender stock, and continues in this condition until the approach of hot weather, when it grows with great rapidity until it ripens its seed. When the seed has changed from its soft condition to that a little tougher and harder, the sorghum is ready to cut. It is bladed first by taking a pitchfork or board removing the leaves, and then the top. If the seed is to be saved, the tops are cut off and stuck in the ground, so that the seed panicles separate and drop over, thus enabling them to dry and cure properly. The stocks are then cut down in wind-rows, if it is intended that they shall remain in the fields for any length of time, as, for instance, just before a frost, and when the farmer wishes the seed kept against freezing. These wind-rows may lie for days, or even weeks, uninjured, but if the sorghum is to be made up at once, as it should be, the crop is bound in bundles, and carried to a mill. The mill consists of two or three iron rolls, worked by horse or steam power, and moving at a very slow rate of speed; through these rolls the stalks are run, and the juice expressed. It is then put into a heating tank, where it is defecated or clarified, mostly with lime, used in the form of milk, or cream of lime. Next it is placed in an evaporating pan, and boiled down rapidly into a syrup of such consistency as the operator may wish to obtain. Ordinarily, 12 lbs. of syrup are prepared by the farming community. A more dense syrup than this will granulate more sugar, but there is the liability of scorching, which operates to prevent the farmer from pushing his fires. The syrup is then placed in barrels or vats, and left to granulate, or is used by families as occasion may require. The clarifying process is the most interesting stage in the manufacture. When the juice is put into the defecating tank, lime is added, until the natural acid of the juice is corrected. This is determined by the use of litmus paper, or by the experience of the sugar boiler. The object of this is to make the juice perfectly free from all woody fibre, gummy matter, or any other foreign substance which would interfere with granulation. After this result has been obtained, whether by the use of albumen or in any other way, the juice is ready to be boiled into sugar.

The manufacture of sugar from sorghum is greatly

on the increase in the United States. One firm at Crystal Lake, North of Chicago, produced last year, and sold in Chicago, 250 barrels of amber-cane sugar, and the year 1879 was the first on which the attempt to produce sugar from this plant was made. The Indians have also been successful in its production at the White Earth Agency, in Northern Minnesota. The cost of the ordinary apparatus used by farmers, varies from £52 to £104. Steam power is usually furnished by some farm engine, either owned by the manufacturer or rented for the occasion.

In a report made by Professor Collier, the chemist of the Agricultural Department of the United States, he states that his experiments have fully settled that there exists no difficulty in making, from either corn or sorghum, a first-rate quality of sugar, which will compare favourably with the best product from sugar-cane grown in the most suitable localities.

POTATO CULTIVATION.

In view of the proposal to purchase seed potatoes for restocking of those districts of Ireland which suffered most severely from the failure of the potato crop last year, the committee of the International Potato Exhibition have drawn up the following series of recommendation, which have been forwarded to the Local Government Board, Dublin:—

1. The land intended to be planted with potatoes should be effectually drained, for if it become saturated with moisture at any time while occupied with the crop, disease is likely to ensue. The neglect of drainage in potato culture has been so largely attended with disappointment and disaster, that it is impossible to overrate the importance of the subject.

2. The land should be prepared by deep digging and liberal manuring with whatever cheap fertilisers the district will readily afford. The cow-byre and pigstye should be regarded as supplying life to the potato crop. Weeds and parings of heath soil burnt in small heaps carefully stopped with earth or clearings of ditches to prevent flame, will furnish an excellent fertiliser at little cost and suitable for every kind of soil. Where the land is poor and sandy, a mixture of kainit and superphosphate of lime, to be used at the rate of from three to five hundredweight per acre, would be likely to prove highly valuable in aid of the crop. In places contiguous to the sea, the people should be encouraged to manure their potato plots with sea-weed, wrack, shells, and sea-sand, all of which contain minerals that conduce directly to the healthy growth of the potato.

3. Only on dry, sandy soils should the dibber be used in planting potatoes. The best mode of planting is to open shallow trenches with the spade or plough, and lay the seed therein at regular distances, to be covered about four inches deep only in the first instance. When the shaws first show, the ground should be well worked between with fork, hoe, or plough, to keep down weeds, and admit air into the body of the soil. In about three weeks afterwards they should be moulded up. It should be impressed upon all cultivators that to mould the plant overmuch is injurious. It is sufficient if the growing tubers are fairly covered. Indeed, if a few are exposed, and become green in consequence, there is no loss entailed, for they can be saved for seed.

4. In planting on the poorest soils, a distance of at least 20 inches from row to row, and of 9 inches from seed to seed, should be allowed. Generally speaking, with land of average quality, and sorts of average growth, a distance of 2 ft. 6 in. between the rows, and of 1 ft. between the seeds, will be found the best. Sorts that are known to be rank in growth must have ample space allowed for the speading of the shaws to the light and air, and with these a distance of 3 ft. and even 4 ft. between the rows will be requisite. So far as may be possible, planting on light, dry lands should be completed during the month of March, and on heavy lands during the month of April. Good crops may be expected from seed planted in May if the work is well done, but the danger of delay in the planting is, that the increasing warmth of the season compels the seed to sprout unduly, and thus leads to a waste of energy. Every detail of potato culture should have in view to conserve the original vigour of the plant.

5. The sorts specially recommended for general culture on heavy soils, and for districts where the rainfall is considerable, are "Scotch Champion," "Redskin Flourball," "Magnum-Bonum," "Irish Cup," "Perthshire Red," and "White Rock." The sorts specially recommended for light land, and for districts that have a moderate rainfall, are "Early Rose," "Late Rose," "Beauty of Hebron," "Manhattan," "Victoria," "Grampian," "Skerry Blue." All those recommended for heavy land may be planted on light land, but those recommended for light land should not be planted on heavy land.

6. The practice of planting small refuse seed has contributed in a most material degree to the deterioration of the potato, not only in Ireland, but throughout Europe. Any seed-tuber weighing less than an ounce and a-half is unfit for planting, and it is to be preferred that tubers averaging two to four ounces should be selected. Seed that has sprouted but little or not at all is to be preferred to that which has made much growth in store.

7. The proper cultivation and improvement of the potato may be greatly promoted by means of competitive exhibitions, at which prizes should be awarded for the best samples, true to name, presented in a clean and attractive manner. In the schedules of all agricultural and horticultural exhibitions classes should be provided for potatoes, with a view to quicken inquiry and promote a permanent interest in the rational treatment of the plant, and the selection of the most useful varieties for particular soils and climates.

8. The so-called "Lazy Bed" system of potato growing should be discouraged except in cases where proximity to towns insures a ready and profitable market for early crops of small-growing sorts of high quality. The robust habited kinds, on which alone dependence should be placed for main crops in agricultural districts, are scarcely amenable to the system, which necessitates close planting, and tends directly to degeneracy of the stock.

CORRESPONDENCE.

CITY GUILDS AND TECHNICAL INSTRUCTION.

To aid the work of Technical Instruction, which the City Guilds are now actively maturing, an attempt is here made to arrange, in a few groups, the City Guilds, according to the nature of the industries which they were created to foster. Towards establishing a system of technical instruction, without waste of teaching power, the grouping of industries, in some form, appears to be absolutely necessary, and Uses govern the present classification.

The City Guilds, at the present time existing, number about 76, representing as many industries; whilst the report on the International Exhibitions of 1871-2-3-4, made by order of her Majesty's Commissioners, which was presented to the Queen, and printed for publication, shows that these industries have now extended to many hundreds. In the case of food, for instance, the separate industries concerned in dealing with food, are nearly a hundred. It should be pointed out that many new and separate industries have arisen, which are not represented by any existing Guilds, such as those connected with printing and the making of books, those treating of cotton, very numerous

manufactures of machines, altogether unknown in times past. For the present, the industries of the City Guilds only are treated in this classification, but it would be useful if all the industries in the London Directory were classified in like manner:—

Group A.—*Industries connected with Food.* (13 *City Guilds.*)

1. Bakers.
2. Brewers.
3. Butchers.
4. Cooks.
5. Coopers.
6. Distillers.
7. Fishmongers.
8. Fruiterers.
9. Grocers.
10. Innholders.
11. Poulterers.
12. Salters.
13. Vintners.

Group B.—*Industries connected with Buildings, Furniture, &c.* (14 *City Guilds.*)

1. Blacksmiths.
2. Carpenters.
3. Founders.
4. Glaziers.
5. Glass-sellers.
6. Ironmongers.
7. Joiners.
8. Masons.
9. Painters.
10. Plasterers.
11. Plumbers.
12. Tilers & Brickmakers.
13. Turners.
14. Upholsterers.

Group C.—*Industries connected chiefly with Clothing, &c.* (9 *City Guilds.*)

1. Clothworkers.
2. Drapers.
3. Fan-makers.
4. Girdlers.
5. Glovers.
6. Haberdashers.
7. Mercers.
8. Merchant Tailors.
9. Patten-makers.

Group D.—*Industries connected with Materials used in Several Handicrafts, besides Clothing.* (10 *City Guilds.*)

1. Broderers (Broiderers?)
2. Curriers.
3. Leather-sellers.
4. Dyers.
5. Felt-makers.
6. Needle-makers.
7. Silk Throwsters.
8. Skinners.
9. Weavers.
10. Woolmen.

Group E.—*Industries connected with the Production of Objects in General Use.* (13 *City Guilds.*)

1. Basket-makers.
2. Clock-makers.
3. Coach-harness-makers.
4. Cordwainers.
5. Cutlers.
6. Founders.
7. Horners.
8. Loriners, or Lorimers.
9. Pewterers.
10. Sadlers.
11. Stationers.
12. Tinplate Workers.
13. Turners.

Group F.—*Industries connected with War.* (4 *City Guilds.*)

1. Armourers.
2. Bowyers.
3. Fletchers or Arrow-makers.
4. Gunmakers.

Group G.—*Industries not Classed under Previous Groups.* (15 *City Guilds.*)

1. Apothecaries.
2. Barbers.
3. Carmen.
4. Farriers.
5. Frame Knitters.
6. Gold-wiredrawers.
7. Goldsmiths.
8. Makers of Playing Cards.
9. Musicians.
10. Scriveners.
11. Shipwrights.
12. Spectacle-makers.
13. Tallow-chandlers.
14. Wax-chandlers.
15. Wheelwrights.

This classification, under Uses, is open to much questioning. It is hoped that it will give rise to discussion, and that communications will be sent to the *Journal of the Society of Arts*. But it is obvious that other classifications under Materials, the several Sciences, such as Chemistry, Physic, Mechanics, &c., may be made.

F. S.

30th March, 1880.

OBITUARY.

Lord Hampton, G.C.B., F.R.S.—On Friday last, the 9th instant, Sir John Somerset Pakington, Lord Hampton, died at his house in Eaton-square, after a short but severe illness. His Lordship was in fair health up till quite lately, and he took the chair at the meetings of the Institution of Naval Architects, held in the rooms of the Society of Arts, last month, although increasing infirmities, due to his great age, had caused him to resign the Presidentship which he had held since the first formation of the Institution in 1860. The late Peer was the last surviving son of Mr. William Russell, of Powick-court, Worcestershire, and a descendant on the mother's side from the ancient and honourable family of Pakington. He was born in 1799, and received his education at Eton and at Oriel College, Oxford. In 1831, he inherited the Worcestershire estates of his maternal uncle, Sir Herbert Pakington. when he assumed the name of Pakington by Royal license. He was nominated Chairman of the Worcestershire Quarter Sessions in 1834, and three years after was returned to the House of Commons as the Conservative member for the borough of Droitwich. He was created a Baronet by Sir Robert Peel, in 1846, but he did not take a prominent position in political affairs until 1852, when he was appointed Secretary of State for the Colonies, in the late Earl of Derby's first Ministry. In 1858-59, he held the office of First Lord of the Admiralty, when he gained great credit by the energetic manner in which he discharged the duties of his position. He was subsequently appointed Secretary of State for War, on the resignation of General Peel in 1866. At the General Election of 1874 he was defeated at Droitwich, after having held the seat for 37 years. He was then raised to the Peerage as Lord Hampton, and in the following year Lord Beaconsfield appointed him First Civil Service Commissioner. In 1857, he was elected a member of the Society of Arts, and in the following year, a Fellow of the Royal Society. He took an active interest in the affairs of our Society, and has served as Vice-President several times since 1862, an office which he held at the time of his death. He presided at a Conference of the Society on Museums and Public Galleries in 1874, and on the occasion of the reading of a paper on the mode of levying the Sugar Duties in France, by Professor Leone Levi, in the following year. He was also a guarantor of the Exhibition of 1862, and a member of several Committees.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

April 21.—"The Present System of obtaining Materials in use by Artist Painters, as compared with that of the Old Masters." By W. Holman Hunt. Sir Coutts Lindsay, Bart., will preside.

April 28.—"Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes." By Thomas Fletcher.

May 5.—"The last Forty Years of Agricultural Experience." By John C. Morton. James Caird, C.B., F.R.S., will preside.

May 12.—"Utilisation of Slag." By Charles Wood.

May 19.—"Trade Routes between England, Norway, and Siberia." By Lieut. G. T. Temple.

Indian Section.

Friday Evenings, at Eight o'clock:—

April 16.—"Russia's Influence over the Inhabitants of Central Asia during the last Ten Years." By Prof. Vambéry. Sir T. Douglas Forsyth, K.C.S.I., C.B., will preside.

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency. Sir William Rose Robinson, K.C.S.I., will preside.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Terrien de La Couperie. Professor Robert K. Douglas will preside.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

April 27.—"Iceland and its Resources." By C. G. W. Lock. John Rae, M.D., LL.D., will preside.

May 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S. William Spottiswoode, LL.D., Pres. R.S., will preside.

May 20.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course will be by R. W. Edis, F.S.A., on "Art Decoration and Furniture," and will consist of six lectures.

Lecture III.—April 19.

Furniture.—Ancient and modern. General. Constructive furniture: mantel-pieces, fireplaces, fenders, closets, lavatories, window-seats.

Lecture IV.—April 26.

The Entrance-hall, Staircase, Dining-room, and Library.—General treatment. Division of wall spaces. Examples of treatment. Decoration and furnishing.

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Errata.—The following have been sent by Mr. Haughton for correction in his paper in the last number of the *Journal:* page 411, col. 1, line 20, for "300," read "170;" page 411, col. 2, line 40, for "Bombay" read "Shikarpore;" line 58, for "3,800" read "2,800;" page 413, col. 2, line 44, expunge word "geographical;" page 415, col. 2, line 67, for "26" read "260;" page 416, col. 1, line 15, for "Artah" read "Acre;" page 416, col. 1, line 20 from foot, for "20 lacs" read "20,000 lacs;" line 10 from foot, for "£17,000 and £270,000," read "17,000 and 270,000 tons."

MEETINGS FOR THE ENSUING WEEK.

Monday, April 19th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture III.)
Royal United Service Institution, Whitehall-yard, 8½ p.m. Major W. Geddes, "Manual Transport."
British Architects, 9, Conduit-street, W., 8 p.m. 1. Mr. James Allanson Picton, "Iron as a Material for Architectural Construction." 2. Mr. Alex. W. B. Kennedy, "Steel."
Medical, 11, Chandos-street, W., 8½ p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Mr. R. Brown, "The Religion and Mythology of the Aryans of Northern Europe."

Tuesday April 20th...Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. H. Scott, "Wind and Weather." (Lecture I.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "Sewerage and Drainage Works," and, time permitting, Mr. H. Hayter, "The Amsterdam Ship Canal."
Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Dr. F. J. Mouat, "The Education and Training of the Children of the Poor."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Prof. Owen, "Descriptions of some New and Rare Cephalopoda." 2. Lieut.-Col. H. H. Godwin-Austen, "The Land-Molluscan genus *Girasia* of Gray, with remarks on its Anatomy, and on the form of the '*capreolus*' of Lister, or the Spermatophore, as developed in species of this genus of Indian Helicidæ." 3. Dr. Max Schmidt, "The Duration of Life of the Animals in the Zoological Gardens of Frankfort-on-the-Main." 4. Dr. M. Watson, "Some points in the Anatomy of the Prosbocidea."
Royal Colonial, St. James's-hall, Regent-street, W., 8 p.m. Sir Anthony Musgrave, "Jamaica."

Wednesday, April 21st... **SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. Mr. W. Holman Hunt, "The Present System of obtaining Materials in use by Artist Painters, as compared with that of the Old Masters."
Church of England Temperance Society (at the House of the Society of Arts), 10½ a.m.
Meteorological, 25, Great George-street, S.W., 7 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Dr. Ridding and the Rev. C. Collier, "Recent Discoveries at Wolvesley Castle." 2. Mr. H. Syer Cuming, "The Martel de Fer, or War Hammer."
Royal United Service Institution, Whitehall-yard, 3 p.m. Prof. Vambéry, "The Past and Future of the Turcomans."

Thursday, April 22nd...Mechanical Engineers, 25, Great George-street, S.W., 7½ p.m. 1. Mr. William Anderson, "Remarks on Chernoff's Papers on Steel." 2. Mr. J. D. Larsen, "Permanent Way for Tramways, with Special Reference to Mechanical Traction." 3. Mr. Henry Davey, "Water Pressure Engines for Mining Purposes." 4. Dr. John Hopkinson, "Electric Lighting" (second paper.
Royal, Burlington-house, W., 8½ p.m.
Society for the Encouragement of Fine Arts (at the Galleries of the Society of British Artists, Suffolk-street, Pall-mall East), 8 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture III.)
Inventors' Institute, 4, St. Martin's place, W.C., 8 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. Charles H. Reed, "Roof Construction in the Middle Ages."

Friday, April 23rd...Antiquaries, Burlington-house, W., 2 p.m. Annual Meeting.
Mechanical Engineers, 25, Great George-street, S.W., 7½ p.m. Papers and Discussions continued.
Royal Institution, Albemarle-street, W., 9 p.m. Mr. W. H. Pollock, "Dumas Père."
Quekett Microscopical Club, University College, W.C., 8 p.m. 1. Mr. J. G. Waller, "An Undescribed British Sponge of the Genus *Raphiodesma.*" 2. Mr. A. Martinelli, "The Mechanism of the Stomata of the Holly."
Clinical, 53, Berners-street, W., 8½ p.m.

Saturday, April 24th...Physical, Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. James Sully, "Art and Vision." (Lecture III.)



Fig. 2.

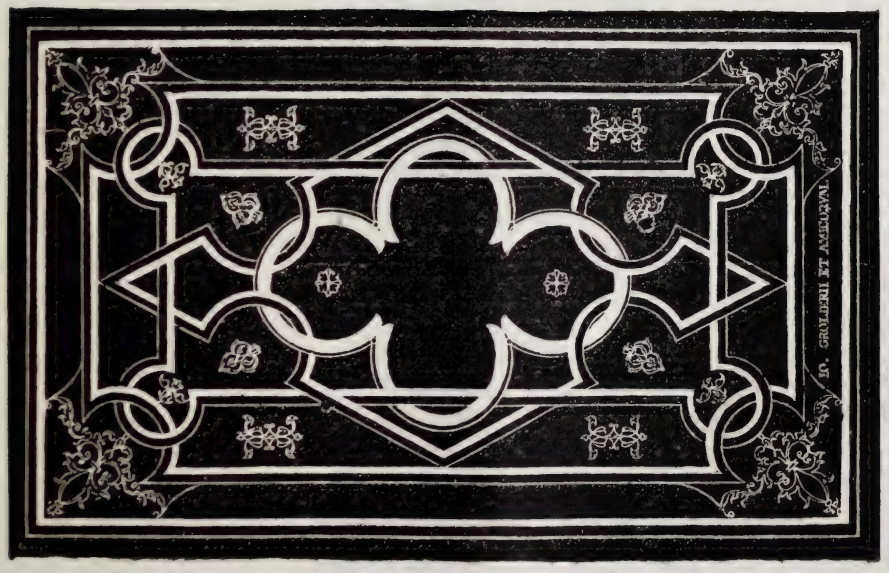


Fig. 1.

Fig. 6.



Fig. 7.



Fig. 10.

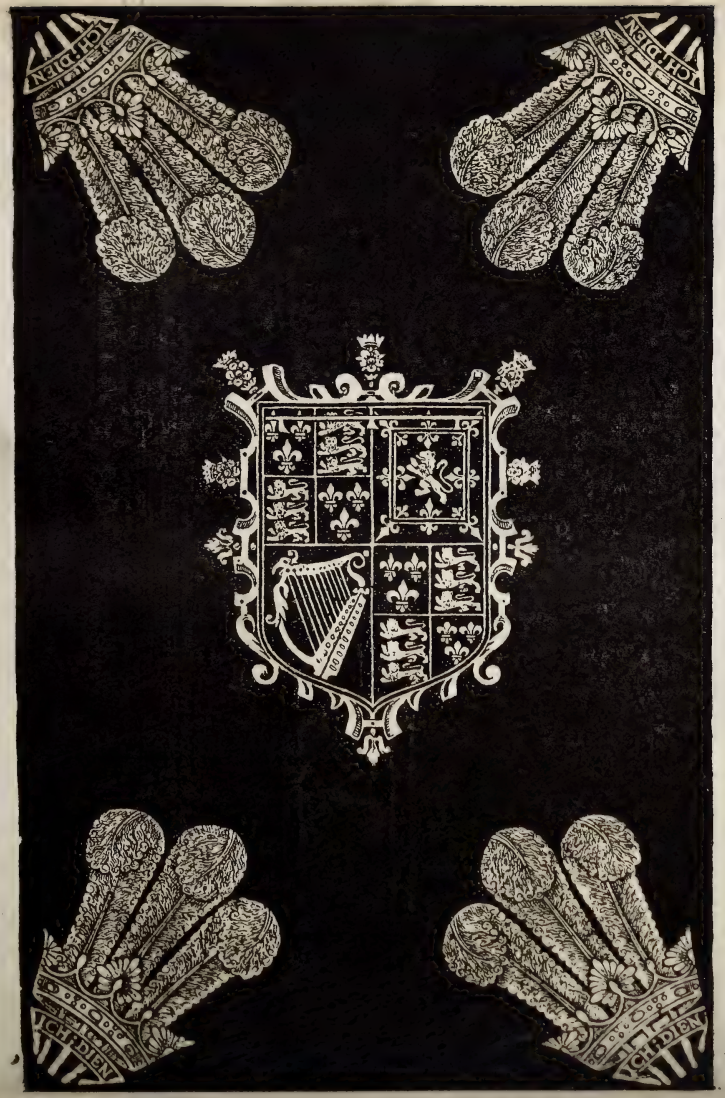
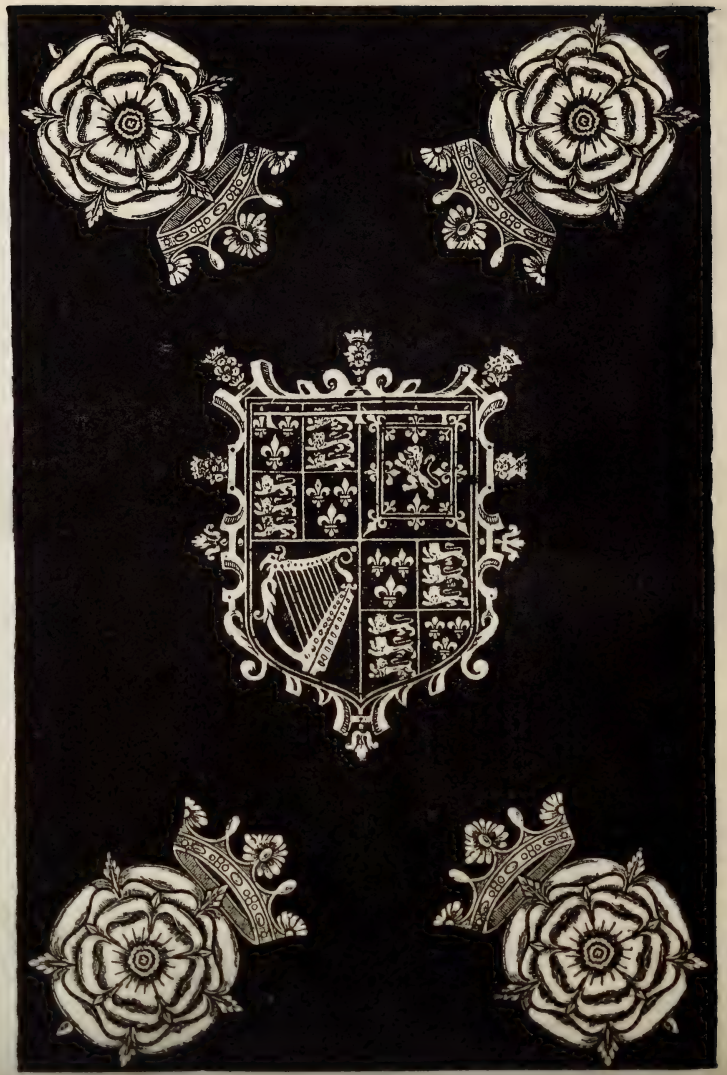


Fig. 11.



JOURNAL OF THE SOCIETY OF ARTS.

No. 1,431. Vol. XXVIII.

FRIDAY, APRIL 23, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HONORARY LIFE MEMBER.

At the last meeting of the Council, Professor Nordenskiöld was elected an honorary life member of the Society, in consideration of his services to science, rendered more particularly during his recent explorations.

CANTOR LECTURES.

The third Lecture of the third course of Cantor Lectures, on "Art Decoration and Furniture" was delivered by R. W. Edis, F.S.A., on Monday, the 19th inst., the special topic being "Furniture, Ancient and Modern." The lecturer treated more particularly of the various forms of mantel-pieces, fire-places, fenders, and window-seats. Specimens of tables, chairs, and cabinets were exhibited by Messrs. Gillow, and of stoves and fire-places by Messrs. Longden and Co., of Sheffield. The Lectures will be published in the *Journal* during the autumn recess.

PRACTICAL EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

An Examination for the above purpose will be held at the House of the Society of Arts, during the week commencing 7th of June.

Candidates must also send a certificate from a professor or other trustworthy authority, to the effect that their qualifications are such as to afford a reasonable chance of their passing. Candidates who were examined last year need not again comply with this regulation. There is no limit in respect to age, occupation, or position.

At the conclusion of the Examination of candidates for the First or Second-class Certificates, the Examiner will record the result, with the marks in each section, on a numbered card, and hand the same to the candidate. The examination of the worked papers in the Honours Grade will necessitate some delay, but the result of this Examination will be conveyed to the candidates in due course.

The Certificates will be prepared as soon as possible after the Examinations, and can be had, upon application at the House of the Society of Arts, on or after the 2nd August, on presentation of the numbered card.

The Council will provide a grand piano and harmonium, and, if necessary, obtain the use of an organ, should candidates for examination on that instrument present themselves. Any other instruments must be brought by the candidates. The services of an accompanyist will be obtained when candidates for singing are to be examined.

The examination for Honours (including the working of the paper) will occupy three hours and a half. That for First or Second Grade Certificates about a quarter of an hour.

The examination of each candidate will be private; no one but the examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee; candidates will, however, be permitted to bring their own accompanyist.

The candidate will be known to the Examiner by a number only; and no list of candidates will be published.

The following are the conditions laid down for the three grades:—

Honours.

The Examination in Honours will consist of three sections, viz., a paper to be worked, an examination similar in form to the practical examination for a First and Second-class, and a *viva-voce* examination.

The paper will comprise:—

[1.] Harmony in four or five parts, each part to be written in its proper clefs.

[2.] Simple counterpoint in the five species.

[3.] Elementary form.

[4.] Instrumentation.

[5.] Questions on the history of music.

Text-books suggested:—Dr. Hullah's work on Harmony (Longmans); Dr. Stainer's work on Harmony (Novello); Dr. Hiles on Counterpoint (Forsyth, Manchester); Dr. Macfarren on Counterpoint (Cambridge University Press); "Form and Instrumentation," by W. A. Barrett (Rivingtons).

The maximum number of marks will be 100.

For a First-class in Honours, candidates must obtain 80 marks.

For a Second-class in Honours, candidates must obtain 60 marks.

Below 60 no Certificate will be granted.

Candidates must pay a fee of 10s., which will include both vocal and instrumental music.

First and Second-class.

Vocal.

Candidates for a First or Second-class Certificate in Vocal Music will be required—

[1.] To sing a solo, or to take part with another candidate in a duet, already studied. Credit will be given for the choice of the piece sung.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds, or successions of sounds, played or sung by the Examiner in that key, and in the keys connected with it; *e.g.*, the dominant, subdominant, relative minor, or other.

[3.] To sing or sol-fa at sight passages selected generally from classical music.

Candidates must come provided with a second copy of the solo or duet they have studied, in the established notation.

The maximum of marks is 100. These will be distributed amongst the subjects of examination in the following proportion:—

Marks.

Voice....20 per cent.	Ear.....20 per cent.
Style....20 ,,	Reading ..40 ,,

Candidates who obtain 75 marks will be entitled to a First-class Certificate; and those who obtain 50 to a Second. Candidates, the number of whose marks is below 50, will be entered as "not passed."

Instrumental.

Candidates for a First or Second-class Certificate in Instrumental Music will be required—

[1.] To play a piece already studied. Credit will be given for the choice of the piece played.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds, played by the Examiner in succession or in combination, in that and its relative keys; *e.g.*, the dominant, subdominant, relative minor, or other.

[3.] To play a piece or portion of a piece at sight.

The maximum of marks is 100. These will be distributed among the subjects of examination in the following proportion:—

Marks.

Execution..20 per cent.	Ear.....20 per cent.
Style .....20 ,,	Reading ..40 ,,

Candidates who obtain 75 marks will be entitled to a First-class Certificate; and those who obtain 50 to a Second. Candidates, the number of whose marks is below 50, will be entered as "not passed."

The fee is 5s. for a First or Second-class (vocal or instrumental) Certificate. If vocal *as well* as instrumental music be taken by the same candidate for the First or Second-class Certificate, a fee of 7s. 6d. must be paid.

Candidates who hold certificates of last year can again be examined, with a view to obtaining a Higher Grade.

Similar Examinations will be held at the Birmingham and Midland Institute, and at the Association for the High Education of Women at Glasgow.

COMMITTEE ON POISONOUS COLOURS.

The Council having had their attention directed to numerous cases of reputed poisoning by arsenical wall-papers and other articles in general household use, have appointed a Committee to inquire into the practicability of preventing the employment of arsenic in any processes by which it is allowed to remain in finished goods, and to obtain evidence as to the effect a total prohibition of the use of such processes, or the prohibition of the sale of articles produced thereby, would have upon various trades.

To promote the object in view, a form containing questions as follows has been issued by the Committee:—

1. In what colours, dyes, mordants, or other preparations used in trades or manufactures in this country, is any preparation of arsenic employed?
2. For what other purposes and processes is arsenic employed?
3. Do you attach any special importance to the continued use of any arsenical colours for preparations, such as leave arsenic in the finished goods? and, if so, what preparations, and for what reasons?
4. Would it be any disadvantage to you if the use of such colours, dyes, pigments, or other arsenical preparations, both of home and foreign manufacture, were prohibited? and, if so, what disadvantage?

The Secretary will be glad to receive answers to the above questions from persons interested in the subjects, on or before the 30th April. Such answers should be accompanied by any further statement or remarks which may be deemed advisable to lay before the Committee.

MORTALITY IN LARGE TOWNS.

The following letter, with the accompanying table, has been sent round, by order of the Council, to the Officers of Health of certain of the chief towns in England:—

Sir,—The Council of this Society have under consideration the arrangements for the Annual Conference on Sanitary Matters, which has been held annually since 1876.

The Council are desirous of bringing under the notice of the Conference subjects which have not been treated in former years, and their attention has been drawn to the rates of mortality prevailing in our great provincial centres of industry. The actual condition of these towns is illustrated by the table enclosed, which has been compiled from the latest returns of the Registrar General, and those for the year just ended (1879). The test employed has been the death-rate among children under five years of age, this rate being the least affected

by varieties of occupation, and most by sanitary conditions of dwellings.

A further examination of the returns shows that a large proportion of those deaths were due to preventable causes, such as zymotic diseases, and they were principally among the wage-paid classes.

The Council would feel grateful if you would inform them whether the experience of your town leads you to the opinion, which the Council entertain, that it is highly important that this subject should be discussed, and, if so, whether you could suggest to them, from your experience, the form of questions which would be most likely to produce practical discussion of a character likely to lead to their ultimate remedy.—I am, Sir, your obedient servant,

H. T. Wood, Secretary.

Towns.	Estimated Population in the middle of the year 1877.	Density, Persons to an Acre, 1877.	Deaths at all Ages.				Deaths of Children under Five Years of Age.				
							Deaths Registered.				
			Mortality per 1,000 living.	Number registered.	Number if Mortality had not exceeded 17 in 1,000 living.	*Number above the healthy Standard of 17 in 1,000 living.*	Number.	Proportion per 1,000 living.	Proportion to 100 deaths at all ages.	Number if general Mortality were 17 in 1,000 living, and the proportion to total deaths were 25 %.	*Excess of Deaths registered over number in last column.*
London	3,533,484	46·9	21·9	77·449	60,069	**17,380**	31,891	69·7	41	15,017	**16,972**
Manchester	359,213	83·7	27·4	9,810	6,107	**3,703**	4,025	83·1	41	1,527	**2,498**
Salford	162,978	31·5	25·1	4,079	2,771	**1,308**	1,966	85·2	48	693	**1,273**
Liverpool	527,088	101·2	26·5	13,904	8,960	**4,944**	6,341	89·6	46	2,240	**4,101**
Birmingham	377,436	44·9	24·2	9,104	6,416	**2,688**	4,461	84·1	49	1,604	**2,857**
Bristol	202,950	45·6	21·8	4,415	3,450	**965**	1,905	73·3	43	863	**1,042**
Leeds	298,189	13·8	22·3	6,630	5,069	**1,561**	3,178	74·2	48	1,267	**1,911**
Sheffield	282,130	14·4	21·9	6,154	4,796	**1,358**	2,765	66·4	45	1,199	**1,566**
Rochdale*	79,481	8·6	19·9	1,584	1,351	**233**	—	—	—	338	—
Oldham	103,559	22·2	24·2	2,495	1,761	**734**	1,137	80·0	46	440	**697**
Glasgow	555,933	92·1	24·8	13,736	9,451	**4,285**	6,253	81·9	46	2,363	**3,890**
Halifax*	90,447	9·3	20·0	1,812	1,538	**274**	—	—	—	385	—
Carlisle*	35,225	2·9	21·9	772	599	**173**	—	—	—	150	—

* These consist of groups of registration sub-districts approximately representing the municipal boroughs.

Memorandum.—The proportion of 25 per cent. of children dying under five years of age to deaths at all ages is thus derived:—

According to the Healthy Districts' Life Table, the per-centage of children dying in the first five years of life to total deaths is 17·5; but this represents the proportion in a stationary population, among which there would be a smaller number of children than in an increasing population. Therefore, if the mortality is the same in both cases, there would be a larger number of children dying in an ordinary flourishing population (see Supplement to 35th Annual Report of Registrar-General, Table 71). Thus the 17·5 per cent. would be raised to about 25 per cent. on the basis of the Table just quoted.

BALMAIN'S LUMINOUS PAINT.

Messrs. Ihlee and Horne, of 31, Aldermanbury, E.C., the proprietors of the patent for the "Luminous Paint," have kindly expressed their willingness to send a specimen of the paint to any member of the Society who may not yet have received one. Any member wishing for such a specimen should send a stamped directed envelope to Messrs. Ihlee and Horne, stating at the same time that he is a member of the Society of Arts.

INDIAN SECTION.

Friday, April 16, 1880; Sir T. Douglas Forsyth, K.C.S.I., C.B., in the chair.

The paper read was—

RUSSIA'S INFLUENCE OVER THE INHABITANTS OF CENTRAL ASIA DURING THE LAST TEN YEARS.

By Professor A. Vambéry.

When the Russians, fifteen years ago, through their conquest in Central Asia, first came into contact with the Moslem population of that part of the world, there was a general idea prevalent that the light of a better future would soon dawn on that people, sunk hitherto in fanaticism and barbarism, and that the influence of Western civilisation would obviously raise the moral and material conditions of the country; nay, it was surmised that man, in this historically famous part of the world, would soon enjoy all the rights which are due to him by nature. Expectations of this kind were not unfrequently raised by the circumstances that the Russian being himself half an Asiatic, would easier exercise any influence over these Asiatics than the Englishman, who, by his superior education and strict European character, is, at all events,

more foreign in Eastern spheres, and less capable to act as a teacher.

Well, to-day, as ten or fifteen years have elapsed, and the picture of the future civilisation of Central Asia is by degrees moving in the foreground, I believe it will not be taken amiss when, far from all political tendencies, and from a purely humanitarian point of view, we put the question, what good has resulted to he peoples of the three Central Asiatic Khanates from the Russian rule up to the present time—what are the cultural and material benefits, what are the promises of the future in this respect? I believe it is only those who, in a fanatical prepossession against Russia, forcibly shut their eyes to undeniable facts, only those will refuse to acknowledge that in the Khanates, where formerly continuous warfare, troubles, and bloodshed were raging, now tranquility and order, and, to a certain extent, also a love of law, begins gradually to spread, and that the horror of despotism and tyrrany, by which Central Asia was haunted during the time of Mollah Khan, Nasrullah Khan, and Khudayar Khan, has almost entirely disappeared. There is no longer to be heard the word *yaghi* (war), which was the terror of caravans, by which hundreds have lost their wealth and liberty; on the contrary, trade and free communication begins to be safe even in the most distant parts of the steppe; and, admitting that not all the advantages of a settled Government are perceptible in Russian Central Asia, it is, nevertheless, the obstinately blind who would refuse to give preference to the present conditions of Central Asia over those of bygone ages.

No, gentlemen, it is not my intention to glory in the epithet of stubbornness; it is my intention to be just towards Russia, but I am also urged to show justice to the *altera pars*, I mean to the Central Asiatics; and, therefore, I am compelled to make the seemingly daring assertion, that all the reforms and innovations introduced hitherto by the Russians in Central Asia are only made for the benefit of Russians themselves, the fact being of getting peaceable subjects, willing ratepayers, and obedient means for the Russian supremacy. I am sorry to remark that the Central Asiatics themselves, far from profiting in the least from the blessings of our Western culture, will derive in the future, from this light of modern culture, more detriment than benefit. It is a sad truth which I have to state—and, in order to do this properly, I must exhibit the whole picture of moral and material decay—when I show you the actual condition of the Moslem people of Central Asia.

It is with great regret that I have to note before all that the domestic industry of Bokhara and Khokand has greatly suffered by the preponderance of Russian imports; that this is one of the chief causes of the rapid impoverishment of the inhabitants of the towns. As you know, the domestic industry of Central Asia was pretty well sufficient to supply the ordinary demands of the people, with the exception of iron wares, linen, and chintzes; nay, even considerable caravans, laden with ready-made clothes, silk and cotton stuffs, went from the chief places in the northern and southern direction to the adjacent countries. Not only the Moslems subjected to Russia, such as the Kazan and Nogai people, but the Russians themselves, were in the habit of buying the long striped coats of Bokhara and Khiva make, which were used as dressing-gowns, retaining, even in Russia, the original Tartar name of *khalat*. Similar was the condition with regard to silk and other articles, whilst to-day, as I hear from Central Asia, a deplorable change for the worse has taken place, and the decrease of demand has greatly injured the Central Asiatic industry. First of all, by the abolition of duty between Russia and Central Asia proper, the last-named country was, so to say, inundated by bad and comparatively cheaper articles, and more than one fanatic Ozbeg or Sart was ready to change the ancestral colour of his blue, red, and yellow canelated *tchapan*, viz., overcoat, for some of the inferior Moscow chintzes.

The second injury to the domestic industry of the Central Asiatics is the daily increasing export of raw material to Russia without the consequent rise of the prices benefiting the producers. It has become evident in later times that the prices of cotton, hides, silk, and dried fruits, far from rising, have gone down considerably. In view of the increasing demand for the respective articles, this certainly seems surprising, if not abnormal; but it must be borne in mind that the Russians have excluded from the Central Asian markets all foreign competition, and that the prices are made as the interests demand. This was, and is almost everywhere the case, and amongst others I shall quote only one example. When the Russians got possession of the Eastern shore of the Caspian, the Turkomans found in the exportation of pitch and naphtha a rich source of wealth. To-day, Armenian Russian traders have come forward as concurrents, and like the Russian *employé* in Tcheleken, so to say, *octroyés* the prices; the Turkomans, thus scarcely finding any reward for their own labour, have made over nearly the whole trade to the intruding foreigners.

It must not be overlooked besides, that formerly commerce between Russia and Central Asia was chiefly carried on by the natives, who started in long caravans across the steppe to the different trading places of the adjacent Russian Empire; to-day, the Russian himself comes with his wares, and not only a great number of Sarts and Tadjiks have been damaged by this innovation, but also many Kirgiz camel owners, who must content themselves with the freights settled by the Russians, and not by themselves; and I may here also casually notice, that the number of these useful animals is rapidly diminishing in the steppes, for during the Russian wars in the last fifteen years, at least sixty thousand camels have been killed on military marches. As easily imagined, the pressure of Russian monopoly lies still heavier upon those articles which were formerly imported from the south, especially from India and Afghanistan, and which have been driven out of the market quite recently by the strict Russian prohibitive duty. You will sufficiently understand how essentially English trade was damaged hereby. I can, therefore, abstain from entering into detail upon that question, but it is not to the English alone, but also to the Central Asiatics themselves, that the exclusion of competition has become a great disadvantage, for the prices of better stuffs having risen in an extraordinary way,

the inhabitant of Central Asia must content himself with lower qualities, brought from Russia, and feels very sensitively the exclusion of foreign competition, even in articles of daily demand. Thus tea was always an article of large consumption in Turkestan, and before the Dunghan Revolution it was mostly imported from China, and fetched prices which were not at all in accordance with the state of wealth of these peoples. This abnormal state of things, supported also by the comparatively greater proximity of India, has already contributed in the beginning of the seventh decade to the opening a trade in the green tea of India with the three Khanates. For a long while the contest against innovation lasted, Kabuli and Kandahari merchants appeared with large quantities of tea in the market, and this Indian article would have certainly carried the point in the end, if, meanwhile, the Russians had not annihilated at once the dangerous intruder. In the first year of the last decade, the Russian Chamber of Commerce in Tashkend provoked a regular tea-agitation in the country. On the one side all possible efforts were made to promote the import of Russian tea, and on the other all sorts of unfair attacks were made upon the Indian rival. The Assam tea was proclaimed to be unhealthy, and to be defiled with swine-fat, so that if the Afghan traders had continued to import it, in spite of the extravagant duty, their experiment would have certainly been frustrated by the crafty malice of the Russians and by the superstitions of the Asiatics. It is only in this way that we can find an explanation of the fact that Indian tea has very little sale in Central Asia, in spite of its superior quality and comparatively cheaper price.

Speaking as I do of the southern direction of the Central Asian trade, I must not omit to mention that, through the eappearance of Russia in Central Asia, Afghanistan and Persia also have been greatly injured in their commercial interest. I speak from private information which has reached me from those parts of the world, and from which I learned that the long caravans, consisting of hundreds of camels, which formerly took their way *viâ* Kerki, Shirabad, Belkh, and Herat, coming in the spring and returning in the autumn, have greatly diminished in the present time, and that Herat as well as Meshed have lost very much of their importance as emporiums and market places. Dyes, pistachio nuts, dried fruits, and lamb skins, usually imported from Central Asia, have greatly risen in price in Khorasan and in Persia, and we must not wonder that the inhabitants of Iran do not much appreciate the establishment of the existing political conditions of Central Asia.

I cannot omit casually mentioning another circumstance, which, during the last ten years, has found an erroneous interpretation; I mean the decrease of the slave trade between Central Asia and Persia. When the Russians appeared in the former country, a general hope was entertained that the province of Khorasan, nay, the whole northern frontier of Persia, always so imminently opposed to the devastations of marauding Turkomans, would now enjoy greater safety, and that the Russian prohibition against the slave trade would be sure to remove a great burden from the shoulders of the Persians. Well, I do not know how far human flesh is a staple article in Central Asia, but I do know decidedly that poor Iran is suffering from that plague as much as before. That the Turkomans are practising this detestable trade only within the limits of their own desert, is scarcely credible; there is more likelihood that the sale of slaves in the three Khanates, particularly female slaves, is going on just as before, and that this act of Russian humanity, of which Russian papers boast so much, is of the same nature as many other humanitarian deeds, by which dust is thrown in the eyes of credulous Europe.

Taken all together, I suppose that even the greatest admirer of the Russian cultural mission in Central Asia, will not deny that the material well-being of the natives in Russian Turkestan is rapidly declining, that their impoverishment is increasing from day to day; and we must not be astonished if the number of Turkestani Mekka pilgrims has dwindled down in the last ten years to almost one-half. The number of pilgrims to Mekka always forms an accurate test of the material condition of any Moslem society.

It may be stated that amongst an agricultural people these various kinds of oppression do not exist, and that, freed from the former tyranny and anarchy of their own Government, they will now, under the protection of an established and regulated rule, thrive and prosper much more. Well, I am sorry to say that, even in this regard, a bitter delusion awaits us, for we make the very sad discovery that the new era did not become very blissful for the people. What rests most heavily upon the labourers of the field is the abnormal taxation introduced by Russia everywhere in Central Asia, a taxation which rises with the continuously increasing deficit of Russian administration. I do not exaggerate if I assert that the Russians have increased five-fold or six-fold the original scale of taxation in Central Asia; and the burden arising from the cattle-tax, land-tax, and personal taxes is, under regulated administration, far more oppressive than with the old patriarchal despotic *régime*. In spite of barbarism and tyranny, the administration of the Khans and Emirs was always influenced by the Mollahs and Ishans, and could never proceed with that iron inflexibility which characterises the uncontrolled system of Russian administration. We must not leave out of account also the continuous vexations and embezzlements of which even Philo-Russian travellers give reports; and we shall with sorrow appreciate what a Central Asiatic acquaintance in Constantinople writes to me, "the voracity of the Karakush (eagle) is as bad as the avidity of our former sipahis (officers)." We must consider, besides, that the cultivator of the soil has, after satisfying the Russian officials, also to give his mite to the mosques, schools, to the Mollahs, to the Kadi, to the Ishan, and to the Dervishes people, whose greed is not less insatiable than that of the Moscovites, and we shall not at all wonder if the poor peasant, fleeced in all directions, looks regretfully back to the former times of tyrannical rule. In those times it was native tyranny which he felt from time to time, whilst now he finds himself exposed to the regular and unceasing spoliation of the foreign intruder.

We may admit, nevertheless, that the material decline is only a temporary, only an evil of the period of transition, and may eventually, in the course of time, turn to the better. We may go even further, and entertain the hope that Sarts, Tadjiks,

and Ozbegs will reach that degree of material culture and well-being which the temperate, diligent, and sober Moslems of Kazan, of the Krim, and of the Orenburg district, have already reached. The material evils are curable, and I do not doubt the good intention of the Russian Government in that respect; but the incurable evil and irreparable loss is the moral decline spreading in Central Asia in such a frightful way, a decline which is entirely owing to the Russians themselves, and can, therefore, hardly be healed by Russia. You will know that the social condition of Central Asia is entirely founded upon the religious constitution—a constitution which took the place of the former old Persian culture, and of the Turanian patriarchal rule—a constitution which has become, in the course of time, the sole regulator of social, legal, and ethnical life. The strict observation of the religious laws, the correct interpretation of the Sheriat, were the only means by which the motley and continually fluctuating ethnical elements of the Central Asiatic world could be consolidated in a firm body. It is through religion that the unsettled semi-barbarous tribes of the adjacent deserts have been brought to the cultivated districts of the three Khanates, that they have settled down, and become, to a certain extent, civilised. Thus we may take religion as the only means which can preserve the Turks and other mixed races of Central Asia from falling back into their former stage of barbarism, in which existed the only safeguard of the Yaxartes and Oxus Valley against the inroads of Seldjukians, Karakhitais, Mongols, Kalmuks, Kazaks, and Ozbegs.

But now the Russians have appeared upon the scene, and their first apparition has sufficed to untie the bonds of religious law, and to shake the basis of ethnical life to its very foundations. The first great fault which the Russians committed was their doing away with office of the Reis, a kind of religious policemen, who has been replaced by a Russian officer. I am far from deploring that, owing to the disappearance of the durra (the three-tailed whip), the observation of the religious law has become very lax, that the mosques are almost empty during the five times of prayer in the day, that ritualistic formalities are more and more neglected. I am not an advocate for Mohammedan ritual, but I cannot conceal from myself the conviction that, with the disappearance of the durra, all kinds of vices are gaining ground; and it is really astonishing how rapidly drunkenness, gambling, and other immoralities are spreading. In the teashops of Tashkend, Khodjend, and Samarkand, brandy is publicly sold, and one-third of the consumers of this Russian national beverage are found among the ranks of the Sarts and of other such people, who, ten years before, would have shuddered at the motion of allowing even a drop of that drink to pass their lips. Cards (formerly called the Russian Koran) were, during the times of my travels in Central Asia, to be found only with the most depraved man-stealers, whilst they now find their way everywhere where large Russian colonies exist, and figure in the criminal records as a chief cause of quarrels and murder. Most shocking is the extent to which licentiousness is spreading from day to day. In order to coincide with the reigning tone of the governing Russian class, even the holiest customs and habits are not spared, and the Mohammedan clergy, formerly the chief protectors of morality, are losing their influence, in consequence of the distrust which the Russians always showed to the Mollah class, in whom they supposed they discovered their enemies. The Kadis also, and Mollahs, by losing their material resources—the Russians having forcibly taken possession of the whole Vakuf—have unavoidably forfeited also their moral prestige. I will admit that morality was in Central Asia, as almost everywhere in the larger towns of Mohammedan countries, always on the lowest level, but formerly the Mohammedans would secretly praise the love of justice of the infidel rulers, so that it is now the more to be regretted that the Central Asiatics, seeing the venality and corruption of the Russian officials, will be quite convinced of the contrary, and they will now believe, that all they formerly heard as to the just rule of the infidels in India, may be also either untrue or exaggerated.

I will not pretend that the Russian Government is intentionally blind to these evils, and that it knowingly abstains from putting a stop to the moral and material decline of the Mohammedan peoples recently entrusted to its care. No, such an imputation would be unjust; but, I am sorry to remark, first, that the chief officials in St. Petersburg, owing to the mendacity of subaltern officers, are not sufficiently acquainted with the real state of affairs; and, secondly, that the means employed to check the evil are either too insignificant or too bad to produce better results. The chief care bestowed by the Russian Government hitherto upon its Central Asian possessions extend mainly to that portion which forms from the lower Yaxartes to the middle course of the Oxus, the highway of future plans and schemes, whilst the districts on either side—I mean to say the khanate of Khokand, the Amu-Derya district, and the interior of the steppes—have been left almost entirely in their old barbarism. It is in order to secure the foresaid highway that the restoration and erection of bridges over the Yaxartes, near Tchinas, and over the Aris, as well as the experiment at irrigating the "Hungerstep" between Khodjend and Djizzak, have been set on foot. The Russian Government has at all times, and in all places, only considered the security of her military roads, not the interest of the natives, who are decimated, as in bygone times, by epidemics, and suffer, as previously, from all the miseries of an apparently European, but in reality Asiatic, Government.

It is true we read from time to time, in the Turkestan official paper, that schools of different sorts have been founded and opened by the Government in the towns of Tashkend, Khodjend, Tchinaz, Samarkand, and in other places of importance. Quite recently, we hear even that schools for girls—nay, a seminary for governesses—has been called into life in Tashkend; but I beg leave to ask whether the Russians seriously believe that the Kirgizes, Sarts, and Ozbegs will rejoice in reading of Aristophanes and Horace, or whether these lights of the classic ages will diffuse modern culture amongst the semi-barbarian and semi-fanatic Mohammedans? To speak frankly, I doubt very much these sanguine expectations of the Russians. What good will be done by sending

five or ten Kirgiz children at Government cost to the schools, and by having them taught there during a series of years? The bulk of the Kirgiz people will scarcely receive a single spark of the light imparted to their children, for these neophytes in our modern culture will remain too distant from the sphere of thought of their own people; they will be too far alienated from the mode of thinking of their own relatives to exercise any influence upon them. The validity of our suppositions is clearly proved by the similar doings of Russia centuries ago, on the lower Volga and in the Krim, where likewise similar schools exist; where also single Tartar children are sent to the Russian schools; and where, in spite of all that, the great mass of the Tartar people still remain in the former state of ignorance and barbarism. It is not by such means (invented and employed only to delude the foreign spectator) that Russia can do full justice to their cultural mission in Asia. The Russians commit a great error when, under the influence of distrust, they take away from the Moslem society of Central Asia even the shadow of autonomy, and when they endeavour to drive them forcibly into the foreign frame of European Russian legislation.

In answer to such an accusation, I may be told that the Russians have installed Aksakals everywhere, and permitted the functions of the Kadis to continue. Well, from a Russian point of view, this may seem a concession, but go and ask what the Central Asiatic thinks about it. Firstly, he knows too well that the Aksakal is nothing else but an obedient tool of the Russian authority, a paid officer of police, who considers the commands of his superiors and not the interest of his own countrymen; secondly, that the Kadis brought into office by the electioneering comedy of the Russians is totally devoid of any power; and that, finally, those Moslem Russian officials, intended to be a kind of concession, are merely Mohammedans in name, and are mostly looked upon as men who, while defending the laws of Mohammed, are mostly bent upon eluding them.

If we throw, therefore, an impartial glance upon the cultural doings of the Russians in Central Asia, we shall be convinced, through evident facts, that the Russian national spirit has neither the capacity nor the wish to introduce the light of our modern civilisation in the interior of Asia, and that it cannot be a propagator of our modern culture from the humanitarian point of view and enlightenment, which is really desirable. Such an assertion may be thought unjust, but, in order to be better understood, I will try to give a concise explanation.

Where Russia meets with semi-barbarian nomadic popular elements, its appearance is so far beneficial that these peoples, becoming divested of their national individuality, are first made Russians, and put upon the lowest cultural level of the Russian peasant. This is shown to us by the history of the last few centuries, with regard to many Fin-Ugrian and Turko-Tartar peoples, whose number has decreased to a frightful degree, having become partly absorbed, partly annihilated, by their conquerors. Travellers of the past century have found the Voguls, the Mordvins, the Suryens, and the Yakuts three times as numerous as they are at the present time. In a similar manner, perhaps not so large a proportion of the Bashkirs and Kalmuks have lost their numerical strength; firstly, they are driven here and there by forced emigrations, then in settlements these peoples gradually lose their customs and habits, their religion, and their language, and become Russians in order to please the reigning class. From the humanitarian point of view, this kind of civilising process must not be much regretted, considering that even the lowest Russian civilisation is a hundred times superior to nomadic existence.

But it is quite different with those who have settled down a long time ago, and have progressed in the direction of Moslem culture, for here the contact with Russia will produce in the beginning a standstill, afterwards a long sickening, and in the end an unconditional collapse. And the causes of these disastrous consequences lie exclusively in the national spirit and national culture of the Russians. I must point, before all, to the marked intolerance which the Russians show, not only to every foreigner, but also to single fractions of their own nationality. It is not here the place to speak of the hard oppression and the ignominious treatment to which the poor Poles, the near relatives of the Russians, are subjected; nor can I enter into detailed accounts of those crying injustices which the inhabitants of Little Russia have to suffer from the hands of their very brethren. Ought it, therefore, to cause wonder that these Russians, wherever they come forward as masters, look upon the representatives of the Moslem culture with haughtiness and contempt, and that it is almost impossible to create an approximation between these two contrary elements? So little attention has been paid to the national honour and self-esteem of the subdued Central Asiatics, that, after a nearly fifteen years' long occupation of the country, scarcely one-sixth of the Russian official world in Turkestan is conversant with the language of the Sarts or Ozbegs, in spite of the notoriously brilliant linguistic capacity of the foreign ruler. To the neglect of the language of the country may be added a disregard for the most sacred habits and customs of the natives. It is true we can scarcely expect from the Russians, who, centuries ago, wrote upon their flags the oppression and the extirpation of the Islam, who continually boast of that task, and who accuse the English who act differently of being unchristian—from these Russians we can scarcely expect the protection and the management of Mohammedan culture.

The unavoidable consequence of such dealing has been, that Russia has become most deeply hated by all followers of Mohammed, that the name of Urus is regarded as identical with Antichrist; and we must not be astonished if between them and the Central Asiatics not the slightest *rapprochement* has hitherto taken place, and that the relations between conqueror and conquered still remain the same as in Baktcheserai and Kazan. In the same way as in the last-named places the well-to-do people have been always anxious to quit their native country, when favoured by time and circumstances, in order to migrate to Turkey; so we discover a similar desire for emigration also in Russian Turkestan, the wealthier Mohammedan citizens of which prefer to settle down in Bokhara, a place where they are threatened by unbounded despotism, but where they, nevertheless, feel themselves happier than under the rule of the Czar.

When single tribes of the Kirgizes, as we learn from recent events, undergo hardships in order to escape from the approaching shadows of the Russian power, by long detours and painful marches from their steppes to the vast plateau of the Pamir, we may well ascribe such movements to the indomitable love of freedom which generally characterises the children of the Steppes; but that the Central Asian inhabitants of the towns, who are brought up in tyranny and oppression, should refuse the blessings of an established rule, that must seem a hard verdict against the Russian civilisers, and must deprive us of the hope that the Russian extension of the power can ever be beneficial to the Moslem communities of Central Asia.

Well, I believe it will take a good deal of time before the cultural efforts of the great northern Colossus will be able to produce more favourable results. Rome was able to govern its distant colonies only so long as the resplendent light of its spiritual supremacy had filled the eyes of the subdued peoples with astonishment and amazement, for the advantages of physical superiority alone were never and in no place of any long duration. The Russian State, or the leading people of it, may well take their stand on the height of their vocation, but the organs of that State, the executors of its orders, do by no means stand upon that level of culture which the importance of their mission obviously requires.

It is in consequence of these faults that the picture of the future of the poor Central Asiatics shows itself in the most gloomy and dark colours. The Sarts, long devoid of any national feeling, will become the obedient tools of the foreign ruler in the valley of the Yaxartes, and may, as in the Zerefshan Valley, the cunning and subservient Tadjik, acquire the ascendancy over the other populations. The Turkish elements, such as the Ozbegs, Kiptchaks, and Karakirgizes will be slighted and injured, and they, notwithstanding their rough exterior, are the most upright and honest portion of the population, and are certainly worthy of a better destiny. To these, the sad prospect is opened of an approach to the Russian culture, after a previous neglect of their own Mussulman education, and to acquire the light of modern civilisation offered to them in the Russian garb, by forgetting entirely what they learned from the Moslem source of enlightenment. It is a real misfortune when we consider that the culture of Moslem peoples can be much easier and quicker effected upon the religious and national basis than upon a totally foreign ground.

But alas! history is inexorable in her destinies. To-day almost the whole Turkish race—from the Yakuts to the Osmanlis, and from the Tarantchis to the Kazikomuks—has been falling under Russian tutelage, and will be led by Russian hands upon the path of modern civilisation. In this respect nothing or little can be altered; but now, I believe, the time has come to put a barrier to this dubious cultural mission of Russia. The Fin-Ugrian and Turko-Tartar elements may (as far as they acknowledge to-day the Russian supremacy) remain also for the future the ground of the Slavonic conquerors of the north, but it ought not to be permitted that the Muscovites should also extend their sway over the populations of Indo-Aryan extraction. The frontier on the Oxus ought to constitute, as in antiquity, not only the political but also the ethnical frontier; just as the cultural past and the degree of civilisation—but not the cultural capacity, as erroneously stated — have always been different in these two chief races of mankind. Hundreds, nay, thousands, of years have (in common with the conditions of the soil and of the climate) produced this difference, and our century of enlightenment cannot ignore it. Not in my capacity as a representative of the first-named (*i.e.*, of the Turanian fraction), but from a humanitarian point of view, do I most earnestly desire that the unjustifiable ambition of Russia should be barred, once and for ever, and that the Aryan elements of Asia should be made over to the guidance and the guardianship of that nation who has become known in Europe by her high degree of culture, by her love of liberty and sense of justice, and who, having proved herself hitherto to be an excellent civiliser, and a true representative of modern culture among the nations of the old world, will never, and can never, become faithless to her noble vocation.

DISCUSSION.

The Chairman said it was quite understood that politics were to be excluded from discussion at these meetings; and, making proper allowance for a few expressions towards the end of M. Vambéry's paper, when a little carried away by his enthusiasm, he had very carefully adhered to that rule. At the same time he had most legitimately placed before the meeting a very interesting picture of the state of society in that part of the world which had lately passed under the Russian rule. It was the fashion to talk of the inhabitants of Central Asia as being sunk in barbarism, and to say that any kind of civilisation—even the rude civilisation which Russia could give—must be a vast improvement on the existing state of things there. There was a certain amount of truth, of course, in that; but there was a limit to that truthfulness, and it could be easily shown that the Mohammedans of Central Asia were not such barbarians that any change whatever must be for the better. He (the Chairman) could claim to speak with some experience on this point, having visited countries which had never yet been brought under the influence of Christian rule. The stories which had reached India of the cruelties of Wali Khan, the ruler of Kashgar, and the oppression and severity practised under the Chinese Ambans in Kashgar and Khoten prepared him to find a very barbarous state of things when he visited that part of the world; but he was most agreeably disappointed to find things very different to what he had anticipated. The Ameer of Kashgar, Yakoob Beg, had rendered himself famous by his rapid conquests and vigorous rule. Doubtless, he governed with very great severity, but the result was, that he brought his kingdom to a state of the most marvellous order. The Ameer professed to follow the Court of Bokhara in his administration; and, therefore, he felt that when he was obtaining an insight into his administration, he was at the same time acquiring a knowledge of the state of things in Bokhara and Turkestan, as they were before the Russians took possession. What struck him as a most remarkable fact, was the wonderful paucity of crime, and the safety of life and property throughout the country. Theft was almost unknown. He had seen bales of goods lying on the roadside untouched, where they had been left by merchants, who, when their camels or ponies had died, had gone to seek fresh animals. No one thought of

touching them, and that was a state of things which could not be found throughout the whole of England. Drunkenness was absolutely unknown there, and gambling was not allowed. Everywhere peace and order prevailed, and there was nothing to be seen or heard in the streets or bazaars to shock the most tender sensibilities. There was a large amount of religious fervour, which was kept up in part by the use of the lash, for he had seen the Kadis going about the streets with straps, flogging people because they did go to prayers as often as was thought right. Still, the fact was patent to everyone, that their religion, however false we might consider it, had a firm hold of the population; and the general effect of the care and attention bestowed on the people by the Mollahs and officials under the eye of the Ameer, was to produce a most commendable amount of what, if it was not civilisation, was a very good imitation of it; it was decidedly far removed from barbarism. He did not, of course, mean to state for a moment, that "all that glittered was gold," nor would he, in dealing with the subject, gloss over the vices which they knew were practised in secret; but he had said sufficient to show that, in order to produce improvement in such a system of society, it was not enough merely to sweep away all priests and all religious practices, but a purer faith and a more righteous code of morals must be substituted for them. In showing how the Russians had failed to improve the moral condition of the people whom they had subjected, M. Vambéry was supported by the testimony of the well-known writer, Mr. Schuyler, and he would add his own testimony of all he had heard whilst in Central Asia. He did not wish to cast stones against the Russians, for he feared we had shortcomings of our own to lament; and it was with no small amount of shame that he had heard the remarks of a Mohammedan gentleman in Kashgar, on the evils of our own rule in India. He alluded particularly to the rapidly increasing tendency to drunkenness, gambling, and other vices which, according to our system of government, it was very difficult to control. M. Vambéry also dealt with the question of trade, and that was a subject which might be considered quite apart from politics, and one very appropriate for the consideration of that Society. Unquestionably, the prohibitive policy adopted by Russia must have an evil effect on the prosperity of the Khanates, and it was a question which affected our Indian merchants at the same time to an equal degree. The trade which for centuries existed between India and Central Asia, and which latterly seemed likely to increase, had been suddenly dwarfed, and almost killed, by the prohibitive orders of the Russian authorities. Those orders were either not known or were ignored at St. Petersburgh; for when, in 1869, he went to St. Petersburgh for the purpose, amongst other things, of inquiring into certain prohibitions against the importation of tea from India into the Khanates, he was first of all told that such an order had never been given. But happening to have a copy of the order, he produced it, and he was then told that they knew nothing whatever about it; that it could not be correct; and that if it ever had been issued by some local authority which they did not recognise, they would immediately have it cancelled. Placing the utmost reliance on the word of the Russian officials, he told the merchants, on his return, that it was a mistake, and that he had been told at St. Petersburgh that such an order had never been issued, or if so, it had been cancelled. But they told him it was not so; it never had been cancelled, and the result was that, from that day to this, the tea had been as completely excluded as if the order had been issued by the Emperor himself. He would conclude with the hope that, whatever might be the turn of events in the political world, some steps might be taken, in the interests of trade, to open up better commercial relations between India and Russian Turkestan, by which means considerable benefit would be derived by both countries.

Sir T. Erskine Perry said he should have liked to say a few words upon several matters, but the Chairman had proscribed the topics to which he desired to address himself. He should have liked to say something on the political aspect of M. Vambéry's conclusions, but he knew that, in doing so, he was before an audience which would be extremely ill-disposed to receive his remarks, because every allusion he had heard made in the interesting paper aggressive to Russia had elicited great applause from the audience. If, therefore, he wished to attempt to contrast the state of Central Asia in pre-Russian times with that which existed now, he was afraid he should find a hostile audience. All he knew of Central Asia he had chiefly derived from the study of M. Vambéry's works, which were, no doubt, well-known to the greater portion of his hearers. In Bokhara, to which the Chairman had alluded, and which, according to him, prescribed the moral tone at Kashgar, they had had a most interesting account from M. Vambéry. He described that there, in the year 1839, the Ameer being on the point of death, and being immensely annoyed at the opposition of the brother of one of his queens, which had proved successful, he called this queen to his bedside and had her murdered before his eyes. That was the morality which was said to be an example to Central Asian Mahommedans. In Khiva also, M. Vambéry said that he was present on one occasion, when 600 prisoners were brought before the Khan, and about 300 of them, being under 40, were selected for slavery, all those above that age being condemned to death; and he himself saw eight of the most aged brought before the Khan, strapped down to the ground, and their eyes gouged out. On the interesting journey which the reader of the paper made from Teheran to Khiva, in the company of a number of dervishes, those men, ragged and rude, paupers as they were, opposed in religion to the people amongst whom they were travelling, were shocked at the instances they found, in every village and every hut, of the slavery existing, where poor wretched Persians had been entrapped into slavery by Central Asian Mahommedans. That was what he found throughout the whole of his ten months' residence in that country. As a lover of truth, he (Sir Erskine Perry) could not shut his eyes to the belief that the presence of Russia in that country was a great benefit to mankind. He had no Russian proclivities; he was himself a Liberal in politics; he did not believe in autocratic Government, and he said that we Englishmen had nothing to do with the Government of other countries, we had enough to do to govern our own. If we did that well, we should accomplish our duty before God and man. In listening to M. Vambéry, he was forcibly reminded that if any foreigner hostile to our Government were lecturing in Russia against the English Government in India, he might present exactly the same chapter of misfeasance on our part as they had heard presented against Russia. He knew India very well, and he believed firmly that for 50 or 100 years past we had endeavoured to govern it as well as we could, but, at the same time, our shortcomings, the failures we had made, and even the suppression of native talent and vigour that a foreign rule necessarily brought with it, might well be laid to our charge; and he thought, therefore, that to an anti-English audience a very forcible chapter might be made against our proceedings there, such as to an anti-Russian audience had been made that evening. He made those few observations because he knew in the present day that anything said against Russia was received with the greatest avidity; and, at the same time, he was quite sure that very little was known about what Russia really was doing. A correspondent of the *Daily News* had been in the parts visited by M. Vambéry, and had given the most valuable information of what was proceeding there; and he affirmed that the conclusions drawn showed that the influence of Russia in those

countries had been beneficial. He believed that to Russia and to England was given the task of civilising Central Asia; he believed, also, that there were no hostile interests existing between Russia and England; and although M. Vambéry, a most eloquent and experienced observer on the subject, believed that Russian influence in those countries was very hostile to English interests, he was bound to say that, after careful study of the question, he was not able to agree with him. In one of his works it was said that the White Czar might imitate the example of some of the ancient rulers of Asia, in coming to Europe with 3,000 or 4,000 horsemen; but he did not think it very probable. For his own part, he was never frightened by bugbears of that sort. Other writers talked of Russia invading India; but when they came to the point, even Sir Henry Rawlinson said that such a fear was wholly out of the question. Then, if we had nothing to fear, why all this struggle against Russian power and Russian influence? He feared he was treading on forbidden ground, but the question was whether Russian rule had been beneficial in Asia or not. The reader of the paper seemed to say it had not been beneficial; but he, on the other hand, contended that to put down the crimes which were to be found existing there, to put down that infamous slavery in every village, which M. Vambéry himself had described, was a good work, and if Russia was doing that work, we ought to support her in so doing.

Sir Rutherford Alcock, K.C.B, said they were all disposed to listen with great attention to one who could speak, not only from general knowledge, but from great personal experience on this question. He would endeavour not to follow in the footsteps of his predecessor; but really, in discussing the influence of Russia in Central Asia, it was very difficult to avoid touching a little on the political aspect of the subject. There might be a variety of opinions on this subject; and no doubt M. Vambéry's, which was founded on a good deal of knowledge, was that it was an unmixed evil, or something very near it; whilst Sir Erskine Perry, who had also a large experience in that region, though not exactly in Central Asia, was of opinion that, although there might be evil attending it, it was, on the whole, a benefit. That was a crucial question, because, if the influence of Russia was really a benefit in the main, it would require very strong political reasons on the part of Great Britain to oppose her progress there; but, on the other hand, if, with some benefit, it was a great evil, independently of any danger to ourselves, that would be a very just cause why we should oppose it, whatever else might come from the advance of Russia. He, himself, had spent a great part of his life in the East, but it was the far East. Nevertheless, one obtained a certain practical knowledge of the Asiatic races in mingling with them. There was a time when the great Mogul ruled over the whole breadth of Asia, from the Gulf of Scanderoon to the Yellow Sea, and there seemed to be a likelihood of the whole of that vast continent coming again under one, if not two, rulers. That great inheritance was now divided into three parts. China, which still retained all the eastern half of Asia, was still the great dominant power there. Russia had spread over the whole of the north, and was tending downwards like a great glacier, as the northern races always had done. England came third, and with the glorious empire of India, and with a certain influence over Persia and Turkey, seemed to be the main barrier to the great glacier which was forging downwards. Whether we should succeed or not in stemming it he would not pretend to say; but from the Bosphorus to the Bay of Bengal and the Eastern Sea, the question was whether Russia should forge downwards, or whether we should defend the south from the advance of that power. In some sense, it was a physical necessity, shown by the natural instinct of the northern races, to forge down to those great sunny valleys which lie south of the Himalayas. It was quite natural they should do so; but seeing that we had, by some marvellous arrangement, obtained possession of India, and that our direct road to India lay through Turkey and the Red Sea, it was quite clear that we, by a sort of physical necessity, must oppose Russia. We should not be true to our own instincts and to the empire we possessed, if we did not oppose Russia coming further south than she was already. The Oxus seemed to be a very natural boundary if she was not to come south to India and Persia. He believed it was on those great lines that our national policy must be founded if it were to have any natural foundation. The question was also important in a commercial sense. It was quite true, as M. Vambéry had pointed out, that there were two powers in Asia—Russia and China—which, wherever their rule extended, pursued a prohibitive policy as strict and rigid as their means enabled them to enforce. As far as the extension of commerce was concerned, wherever they came, there was a prohibitory tariff enforced, and in that respect also it was not desirable that Russia should be permitted to extend her power. Those seemed to be the leading points which it was necessary to bear in mind. Central Asia was more or less stirred up throughout by those great Mohammedan insurrections, which had nearly torn China into fragments; but she had, with her old traditional power, put them down in the only way in which the Asiatic Powers did put down insurrections, by exterminating the whole Mohammedan population. She had done so in Yunnan, after a kingdom had been founded there for ten years. People said China was effete; but she roused herself one morning, and in less than three months there was not a Mohammedan left alive in the whole province. We might say that was barbarous and atrocious; and so it was; but in that way only did they understand making war, especially in dealing with rebels and insurrections. More than ten years ago, Eastern Turkestan had slipped from her grasp. Russia had put her paw on Kuldja, and it was even a question with England whether we should not make a treaty of commerce with the Russians, because though China theoretically had not given up her sovereign rights, no one presumed she would think of venturing again thousands of miles from Pekin to attempt to recover a province, which, after all, might be considered to be of but little value. But one morning they awoke, and after traversing a couple of thousand miles, and waiting to plough the ground and sow the harvest which was to feed their troops, they appeared in Eastern Turkestan, and swept away every Mussulman rebel against their authority, and in the course of a few months, not one was left alive. That showed us that we were not to assume that there was only Russia in Central Asia, or only ourselves in the South. Russia, China, and Great Britain were the three heirs to the Empire of the Great Mogul, and between the three they must settle what was to become of it, and whether it should be allowed to pass to Russia.

Captain Gill R.E., said he was not able to speak with the experience M. Vambéry had, but there were a few words he should like to say. The great danger people fell into in looking at this question, was in accepting, without question, any statements which might be made, so that they fell in with their own views of the case. What we ought to do was to weigh carefully everything which might be said, and see where the truth lay; and it was his belief we should always find that the truth lay between the extremes. He did not believe in the extreme beneficial influence, nor did he believe in the extreme bad influence of Russia wherever she went. He believed that she did good and harm as well; but the great question we had to consider was not so much whether Russia did good to the Central Asian provinces she might conquer, as whether her influence was adverse to our own in Asia. He did not believe in what he called "Brummagem morality," which set itself up

and called upon all Englishmen to do what those Brummagem people thought moral, without considering that which was for the benefit of the empire. He believed we ought to consider the good of our own empire, and to do what we considered most for the benefit of the people over whom we were called to rule. If we looked at the action of Russia wherever she had gone, we should not find that she had been mindful of all her duties; but, at the same time, we should find that she had done a considerable amount of good in Asia. There was no doubt that she had to a great extent put down slavery, but he maintained that we ought to consider our own interests. He had met Russians in many parts of the world, and he had never met a Russian of any intelligence, who did not laugh at the idea that English and Russian interests were the same. He had always found them declare that England was the natural enemy of Russia, and that their interests were antagonistic. This had been always said to him with the greatest good faith and kindness, and, indeed, he had always been treated with the greatest kindness and hospitality in Russia, but he could not hide from himself that the great dream of Russia was the invasion of India. We might laugh at it as chimerical, and he quite believed that any invasion of the kind would be repelled with great loss. But she had other means at her disposal besides her own forces, she had the means of setting at work such countries as Afghanistan, so as to cause trouble to India, and we ought as Englismen to consider this question as well as others. He wished that English men and women would not take up either side violently, but be on their guard against evil wherever it might appear.

Mr. Trelawney Saunders wished to express the plain and simple opinion of an Englishman that nothing could be worse than to follow the advice to treat this subject as one to be dealt with on mere general principles. He would urge them to remember that just as far as Russia went, she excluded England from her markets. He could not agree with Sir Erskine Perry that we ought to stop at home and mind our own business. Our home was on the sea; the very food we eat came from foreign countries; and we had a warning the other day in the attempt to rig the New York market, and raise the price of corn. We depended on foreign markets to keep our mills going in the north, and we could not allow any one to narrow those markets. We must keep our navy powerful enough to secure the safety of the seas. One of the first incidents of the Russian occupation of Turkestan was the sudden collapse of the trade in chintzes at Tabriz, and at last it was found that the Russian occupation had closed the market. Wherever Russia went she excluded England, and it was our business to keep the markets open.

Mr. Hyde Clarke, D.C.L., said that, adhering to the Palmerston policy, he differed altogether from his brother Liberal, Sir Erskine Perry. With regard to Central Asia, he had not, of late, had the direct means of correspondence which he formerly possessed; but he could call M. Vambéry's attention to a state of affairs which tended to confirm his recent experience. He remembered very well when seeing Mussulmans from the Caucasus formerly, that they were very well satisfied, and by no means disposed to revolt, the reason being that they were left in possession of their own institutions, and, to a great degree, of their own administration. The Russians had been pointed to by many statesmen formerly as amongst the best rulers of foreign populations; and, with regard to Mussulmans, they kept up a fine school at Kazan, where the principles of Mussulman law were still taught as in our old Haileybury College. But of late years, in consequence of the spread of Panslavism, the whole character of Russian administration had altered in those respects, to which M. Vambéry had referred, particularly in the points where some thought he rather took a sectarian, or a too religious view. Instead of maintaining the local administration and the old principles of morality, it had now completely disturbed them. Within the last few years the Russian policy had completely altered, and was attended with cruelty and atrocity. He wished to call the attention of the meeting to one way in which we might deal with this question, without any warlike or political action, and that was the means we had of communicating with those populations, and acting upon them. One step had been already taken by her Majesty's Government, by providing an educated staff of student dragomans, speaking Turkish, for the use of Turkish diplomatic and consular service. Those connected with India would know what a great advantage it was when the Persian Embassy and the agencies there had been under the influence of the India-office. The consequence had been, that they had been able to send there men well acquainted with the language, literature, and institutions of the country. Now, the Government had instituted for Turkey a system of student interpreters, who, after passing an examination here, went abroad to complete their studies. There was another step which might be taken in the same direction, namely, by making some small provision for the cultivation of the Turkish language here. Another thing would be, to avail ourselves of such opportunities as now existed in India, for the promotion and study of the Turkish language. He called attention to this matter, because the better we were acquainted with the language of these populations, the better should we obtain that information which was so desirable.

Mr. Scott Russell F.R.S., said he should endeavour to avoid politics as far as possible. For more than 30 years he had known Russia thoroughly, and for a somewhat shorter time he had also had the opportunity of knowing Turkey and Asia thoroughly. He had been on terms of intimacy with Russian statesmen, and had discussed with them their policy as regards England. On the other hand, the Turks in Constantinople and in other places had always received him with great kindness, so that he did not know whether he might be considered a Russian or a Turk, but perhaps he might be allowed to mediate between the two. He thought a good Turk was a much better man than a bad Christian, and he said this in confirmation of what had been said, that the greatest wrong that could be done to one of these Oriental countries, whether it were done by Russians or by Englishmen, was to introduce a mongrel Western civilisation into a country which happened to be a well-governed, religious, and industrious community, like many of these Eastern communities, which English people called heretics. Perhaps the ladies present would allow him to disabuse them of the prejudice they had against the Turks, that each of them had a great many wives. He laboured under that impression himself at first, but, having the honour of the confidence of those gentleman, he had discussed the point with them in the most serious manner, and he wished to give the meeting the benefit of the enlightenment he had received. A Turkish gentleman asked him how he thought they could all have a great many wives when the statistics (which he afterwards proved to be correct) showed that for every four Turkish men there was only one woman. "Besides," he said, "why do you think I should have in my house three wives? If I were to venture to bring another woman into my house, I should have it pulled down about my ears, the same as you would." He had seen the private and domestic life of the agricultural inhabitants constituting those beautiful village communities of the East, and in gentleness, in hospitality, in morality, they had his unfeigned admiration. It was not necessary for Russian bureaucracy or English civilisation to go into those communities with the view of rendering them more civilised or moral than

they now were. One thing only we could do for them and he did not know anyone who could do it but the English Government, with their wonderful staff of Indian officials. The Turks were ill-governed. All the evils of Turkey and the East came not from below but from above, and he knew no way of reforming those Eastern communities but the way the English Government adopted, of leaving them their own village governments and their own traditional ways, introducing merely an administration capable of governing them and teaching them that their superiors could be honest, wise, and kindly, instead of being, as they were accustomed to see, plunderers and unprincipled devastators, coming in under the pretence of ruling them for their benefit, but, in fact, carrying off from them their property and their independence. One word more with reference to our inevitable jealousy of Russia. He thought we said a great deal of Russia she did not deserve; and, on the other hand, she deserved a great deal of blame which *she* did not think she deserved. If she would, Russia could easily agree with us on a certain line of demarcation which she would keep to. He had discussed this with some of the greatest statesmen of England and of Europe. It was not a difficult matter to draw a line of demarcation at all the points where our interests came in contact with Russian interests, by which a fair compromise could be arranged between the two, and which would be beneficial not only to the natives but to the two interfering parties. But there was one condition necessary to the possibility of carrying that out, and that was to lay down a fixed policy, and say, "Now we have agreed on that line we will keep to it, and if any country—Russia or another—should trespass beyond that line, she shall pay the penalty instantly." If we should ever be happy enough to possess a Government which would say openly and candidly, "That is our decided policy; cross that line and there will be a declaration of war," there would be no war. The only difficulty was, that statesmen sometimes said, "If we made the best possible conclusive arrangement with Russia to-day, where would it be this day ten years?" But he was persuaded that if we had a strong Government which would lay down such a policy and adhere to it, there would be an end to all our troubles.

M. Vambéry, in reply, said he was sorry to find that part of his paper had not been quite understood. He did not say that Russian influence over Central Asia was not beneficial at all, and he would allude to what extent it was beneficial. One must be really totally blind to ignore the fact that the present condition was a hundred times superior to the former. Russia had done good, but she had not done good enough according to our European value of culture in the East, and she was scarcely able to do full justice to her vocation as a civiliser in the East. Before he left Pesth, he was asked, "Why do you go now to London, where there is such extraordinary weather?" But he was determined to come to England even now, when there was a great amount of Russian wind blowing. He came to England, and really was surprised to find that he had to defend England before Englishmen. The subject on which he had been speaking was not so much a political as a social one. The question before the European or Christian world was to decide who should be the civiliser of the East and the protector of our European culture, Russia or England? He was neither a Liberal nor a Conservative; he was not even an Englishman; but he was proud to be known in this country, and of being the defender of England's rights on the continent. He was a Hungarian, and would remain true to his national views; but at the same time he would like to be a man, and he should like to know, as a man, that the vast countries of Asia should be happy. In consequence of his desire to see those countries happy, he was anxious to know who could make them happy. That was the subject of his inquiries, and the reason of his political writings ten years ago. It might be said that civilisation was one and the same, whether it came through a Russian channel or an English one; but he was not of that opinion. There was a great difference. Both might be Christian, but they were not like one another. There were certain political Englishmen who were more Russian than the Russians themselves; but no one could deny that Russia was a younger nation. Full of ability, she might become, after a century or two, a very enlightened nation; but she was not so at present. Now, if they looked round for an enlightened nation, England was really fit to be the civiliser of the East. It might be said that he came to flatter England; but he had no reason to do so, and in spite of all political discussions, the truth ought to be stated frankly. How could they compare Russian civilisation with English? It was not possible. Take Ivan the Terrible, who conquered Kazan more than 500 years ago, and whose conquests were afterwards extended to the Crimea. If you went to Kazan, you found the Kazan Tartar was the same as he had been for 500 years. But he was not only a Tartar: he knew a little of Mohammedan civilisation, which he got from the Mohammedans. Now, how many years had elapsed since the battle of Plassy, and since Warren Hastings had done his wonderful work in India? Of course they grumbled; and every people who had to be civilised would grumble. He had met many Indians who spoke English, and knew something of English literature; and what was the number of political papers in India now-a-days? The Government had been obliged to bring in a Bill against certain writers, who were too extravagant in their views; but had the Russian Tartars any papers in their country? He never saw a paper among them in his life. Then how could Russian civilisation be compared with English? When it was said to be a blessing for humanity that Russia was spreading, he could only express his wonder that any Englishman should say such things. He admitted that what Russia had should remain in her hands; the Tartars should remain under Russian superintendence, but let Russia civilise the Tartars. She might come to the Oxus, but he objected to her crossing that river and going into Afghanistan and from Afghanistan into India. The people on the left side of the Oxus belonged to the Aryan race, a race very different from those on the other side, a cultured race, and really deserving of something better than Russian tenderness. It was in the interest of Europe to make a line of demarcation between the cultural mission of both nations. The Russian influence extended from the Glacial Sea to the Oxus, and the English from the South also to the Oxus, and to make such a line would be the only way to bring about the civilisation of Asia. England had a right to exert influence over Anatolia and Asia Minor, and in Persia, which country was beginning to know what was for her good, and to repent of her past mistakes. She was now beginning to know that England was the only power on which she could lean. Then came Afghanistan and the great Indian Empire, and there was reached the end of the Mussulman world. The southern part was almost entirely in English hands. Above the Volga, and crossing the great steppes of Turkestan, even to Chinese Tartary, the Russian influence predominated. The only way to avoid a collision—which he certainly should deprecate, for it would be the saddest thing possible—a frontier line should be drawn, and England should say plainly "Hitherto, but no further." He concluded by thanking the meeting for the kind attention they had given him, and the undeserved reception he had met with.

The Chairman then proposed a cordial vote of thanks to Professor Vambéry for his able paper, and the instructive suggestions he had put forward, which, he had no doubt, would sink deeply into all their minds, and would probably bring forth some fruit.

The resolution was passed unanimously, and the meeting separated.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 21st, 1880; Sir Coutts Lindsay, Bart., in the chair.

The following candidates were proposed for election as members of the Society:—

Barrington, Viscount, 19, Hertford-street, Mayfair, W.
Batten, John Winterbotham, 3, Harcourt-buildings, Temple, E.C., and 35, Palace-gardens-terrace, Kensington, W.
Cadogan, The Earl, Chelsea-house, Cadogan-place, S.W., and Babraham-hall, Cambridge.
Da Costa, David Campbell, Porchester-gardens, W.
Davy, David, Sharrow Knoll, Sheffield.
Dent, Edward, 11, Old Broad-street, E.C.
Devlin, James, 2, St. James's-villas, Urswick-road, Lower Clapton, E.
Ferrers, The Earl, Staunton Harold, Melbourne, Derby.
Hardwicke, The Earl of, Horseneath-lodge, Linton, Cambridge.
Ilchester, The Earl of, 42, Belgrave-square, S.W.
Mackey, J. A. D., 5, King's Bench-walk, Inner Temple, E.C.
Pembroke and Montgomery, The Earl of, Wilton-house, Salisbury.
Smith, George John, Trevu, Camborne, Cornwall.
Watson, William Livingstone, 21, Buckland-terrace, Belsize-park, N.W.

The following candidates were balloted for and duly elected members of the Society:—

Acheson, William, 2, Montpelier-square, S.W.
Barcroft, Henry, The Glen, Newry.
Bertram, Henry John, 100, Dean-street, Soho, W., and 25, Brecknock-crescent, N.W.
Dale, David, West-lodge, Darlington.
Dent, Alfred, 29, Chesham-street, S.W.
Gilbert, Walter Knapman, 2, Queen-street-place, E.C.
Hand, Commander George W., United Service Club, Pall-mall, S.W.
Helliwell, Thomas William, Newlands, Brighouse, Yorkshire.
Kelly, Frederick, F.R.C.S., Hotel de l'Europe, Brussels.
Potts, Joseph, Jun., North-cliff, Roker, Monkwearmouth.
Quinlan, Thomas, Royal Army Clothing Department, Pimlico, S.W.
Schiff, Charles, 43, Lothbury, E.C.
Seligmann, Edward, 34, Clanricarde-gardens, W.
Winter, F., 138, London-wall, E.C.

The paper read was—

THE PRESENT SYSTEM OF OBTAINING MATERIALS IN USE BY ARTIST PAINTERS, AS COMPARED WITH THAT OF THE OLD MASTERS.

By W. Holman Hunt.

The subject about which I feel called upon to address you, I am glad to be able to point out, makes no demand for oratory; although an eloquent lecturer would, doubtless, find means to make the address more attractive. I must premise too that I have no pretension to chemical knowledge. Such science might, at first, be expected in a painter who should address an audience both scientific and artistic; but I have been led to reflect that the chemical investigations necessary for the purposes of art should be left to analysers much more profound than any that an artist could become. Imperfect knowledge has misguided many experimentalists; it would certainly betray me were I to pretend to teach. One of my main objects is to explain what are our most serious difficulties and wants, and I shall speak, in the hope that a greater interest may be awakened among chemists when they are convinced of our great desire for their help, which they could scarcely yet have been expected fully to realise.

The aim, you will understand, is simply to make a comparison between the system adopted anciently by painters to supply themselves with materials for their work, and that at present in vogue in Europe; to weigh, without prejudice, the good and the bad of this last, and to search for modes of improving the present arrangements which do not prove satisfactory.

As my object in going back to early authorities is not to satisfy historical research, not to bring forward hitherto unknown facts, or to dispute any regarded as settled, I need scarcely apologise for having to trust only to my memory of past reading for the data of that part of my lecture which comes first in order. I affect only to remind my hearers of those facts which the life-long experience of a painter singles out in his reading as of vital importance.

The Egyptians, the Assyrians, and the people of Pompeii and Herculaneum, had for colours—first, the natural earths; second, the colours made from stones; and, in addition, chemical combinations, which, by modern analysis, have been proved to be products indicating no little skill in their makers. Pliny speaks of colours, both natural and artificial, as in many cases brought from particular and distant localities. Vitruvius bears witness to the fact that colours came from divers places; and in Pompeii, one of the stores excavated had, in some of its jars, pigments of different origin, ready for sale. The merchants merely collected them. All evidence establishes the belief that the materials were sold in their unmanipulated state—that the painters themselves prepared them for use.

The practices which were found in action at the revival of painting in Italy had, probably, been transmitted to painters by their Roman and Greek predecessors and what these habits were we are able to realise with wonderful precision; from receipts written by monks whose fraternities undertook the illumination of missals, the painting of walls in fresco, and other devotional operations for the decoration of religious service, and, further, the preparation of the materials necessary for such work. Eraclius, in the 10th century, with many art-craft secrets, left record of the use of colours mixed with oil, and even with varnish. This is the earliest evidence discovered of what is regarded as the most permanent means of exercising our art in its more complete form. The instructions contained in this book, and in that of Theophilus, refer to every kind of decorative work, and, therefore, give much information about the preparation of colours and such matters of importance to painters. Quite alone, however, as the great mouth-piece of the new living art, standing on the foundation-stone of its temple, great alike in the spirit of reverent humility and zealous confidence, is the very valuable handbook for the use of practisers of the art by Cennino Cennini. The especial value of this

book consists in the fact that the writer gives us, not prescriptions only, but the records of the life-experience of himself, of his father, and of many generations of predecessors. Colours which are manufactured he speaks of as best procured from particular vendors. Many, we know, came from monasteries famous for such produce. Signs of character, by which the varieties for special purposes shall be chosen, are given. Some of the earths the reader is himself directed to dig up in specified localities near Florence. These are, however, introduced into the studio scarcely less sophisticated than those bought in the market, for the means of purifying and preparing are given for each. The habits of pigments are described as by an experienced manipulator. In one case, the writer, speaking of a red earth, says the more it is ground the brighter it will be; so that, if you spent a whole year in triturating it, the tint would be the brighter; and of vermillion, he adds, twenty years' labour would be advantageously bestowed on it. He speaks of pigments which are fugitive, and of the means, where such exist, of correcting such defect. He cautions the practitioner against colours which will not harmlessly mix together. Of a colour called dragon's blood, he advises his readers to leave it alone, for that it is not of a kind to do honour to the workman; and revealing his honest and enthusiastic soul, he glories over the merits of those good servants in the colour-world which are spontaneously excellent. He heralds in one colour whose name is familiar to us, thus:—"There is a yellow colour called *giallolino*." Further, he says, "This colour is used in fresco, and lasts for ever;" and he winds up with "When employed in painting, it is a very beautiful yellow, and, with this colour and other mixtures, which I will describe to you, you may paint beautiful foliage and herbage." It is "Naples yellow." Such a colour should certainly not be discarded even now. Of ultramarine, the heavenly colour, he writes with worshipful tenderness; with more than this, with triumphant acclaim of its nobility, its beauty, and its perfection. He describes how the painter should select his skins for brushes, how he should preserve them from the ravages of moth while kept in store, and how, at last, they should be made up. He explains of what wood panels should be made, and even—if I do not confuse him in this point with some other writer of the time—at what season of the year the tree should be felled, to ensure that the wood shall have no embryo brood of worms within it. He directs us how to clean old panels from damages already suffered; that old nails should be extracted; that the rust should be cut away, lest this should afterwards eat through the prepared surface; and he explains with what composition the hole should be filled. This wisdom bespeaks the experience of previous generations, as it testifies, also, to the general understanding that an artist, before all things, should acquire a thorough knowledge of the materials on which the stability of his art depends. Indeed, in one passage, he declares (listen to this, oh! students, who have chosen the profession of Art because it is a light pursuit!) that, to become an artist, a youth should devote himself for the first seven years of his career to the mechanical part of his pursuit, *i.e.*, prepare wood for panels, pulverise gesso, make glue, lay grounds, use pumice, grind colours, &c. By this, however, it must not be inferred that exclusive devotion to the drudgery is meant, only that, during the time named, he has this part of the duties of the workshop upon him. This responsibility, let it be here noted, did not prevent many painters—Massacio, to wit—from gaining, while still in first youth, a glorious immortality. In conclusion, he remarks that there are men, calling themselves painters, who boast of having had no master, of being self-taught; and, referring to the labours which he so minutely described, he ridicules the boast as a preposterous one.

The details of the different tasks, in this work of preparation of materials, may suggest to the artist of to-day that the *pittori* of the *trecento* was humbler in station, and more like the artisan of our century. Some of Boccacio's stories show that the ordinary painter was, indeed, a humble and, socially, an unambitious man; but Cimabue and, notwithstanding his Boorish origin, Giotto, were cavaliers associating with the best society, and these two were the art ancestors, the teachers of Taddeo Gaddi in mechanical lore (and this is declared distinctly), as well as in art cunning, and Taddeo Gaddi was master to the elder Cennino; so there is no reason here to think that the greater artists were more ignorant than the humbler ones of the manner of preparing their materials. In the later development of the art, we indeed find ample evidence that the highest did not scorn to cultivate and to seek the mechanical skill and the chemical knowledge which promised them safer or more beautiful grounds, and colours, and mediums with which to work. The history of Van Eyck's discovery hinges upon the artists' devotion to the menial part of their work. The story of the transference of the secret to Italy, with all its apocryphal incident, reveals how well grounded the best painters still were in mechanical skill. The anecdote of Leonardo da Vinci, which represents him distilling oils, and making other preparations, until his patron complained that the painter would never begin his picture, shows how humbly painstaking he was in his habits. "The Ancient Practice of Painting," by Mrs. Merrifield, which has specially valuable gleanings of the processes of the painters of the period when canvases were first introduced for important works, shows how favourite preparations were adopted by the various artists; and Eastlake's very valuable and—to a painter—most interesting collection of anecdotes, facts and observations, gives a good store of evidence of the knowledge coming from long attention to what would, in this day, be regarded as work beneath the profession. Advice from Titian is quoted, to friends as to worthy colours and modes of work; his canvases are found by restorers to be prepared differently from those of others of the time; those of Paolo Veronese are peculiar also; Bassano differed from either—facts showing that the studios were the painters' workshops. The story is reported of Correggio's friendship with a celebrated chemist, who gave him much help in the preparation of oils and varnishes, and whose portrait, painted by the painter in gratitude for services rendered, still exists at Dresden. Vasari was writing at this critical time, and he takes pains to tell of processes peculiar in the practice of the artists whose lives he gives, and

he also explains his own views of what is best. Filarette, Borghino, Volpati, Volumini, Armenini, are painters whose records carry on the story of personal painstaking. Le Brun—a French contemporary of Rubens, but not the author of the hideous book on human expression—brings the light to the later northern modes of work; and Dr. De Mayerne, physician in London at the court of Charles the First, preserves some valuable information about painting in his time. He tells of choice colours; of vermilion, prepared by a chemist in Holland, three times brighter than any other. He tells of Vandyck's habits—that, for instance, he mixed all his colours except vermilion on the palette; and he explains, from the painter's own instructions, the expedients he adopted to make dangerous colours—blues and green are specially mentioned, while orpiment is referred to as specially difficult to manage—safe from contact with pigments which would ruin them, and how thus he succeeded (as Titian had in the "Bacchus and Ariadne"—probably by the same means) in making it permanent. It was simply to paint the part strongly in light and dark. When quite dry, to pass a coat of varnish over this; later, to lay a mordant on the glassy surface with the juice of an onion; to apply the fugitive paint with the white of an egg; to varnish a second time, and so leave the fickle colour shut up in amber, or other pellucid sheets of gum. The practice of Vandyck, as recorded by such contemporaries, seems to have changed from that of the Venetians in respect to the varnish he used with his colours, which was no longer amber or copal—at least, exclusively—but mastic. Correggio had used *olio d'abezzo* and sandarac varnish, the effect of which is not good for the soundness of his pictures at Parma, although, perhaps, a certain clearness and brightness is due to these colourless gums. A diary of Queen Anne's time, published some twelve months since, refers to a picture by Vandyck, which had got into such bad state that it was necessary to send it to a restorer, who, in his report, afterwards declared Vandyck's grounds were often very carelessly laid, and that the characteristic slovenliness had, in this instance, caused the rapid deterioration; this, it was pleasant to find, was at last effectually checked. It is profitable to consider Vandyck's habits when he was planted in England, where, undoubtedly, he, both consciously and unconsciously, became the leader to many younger brothers of the brush. Dobson was his selected *protegé*, and through him, perhaps, the use of drying oil mixed with mastic varnish, which was the stock medium till lately, was first introduced into England. Eastlake quotes a story of a paint-box left at a farm-house by a soldier on the march, in the Parliamentary wars, who never came back from the neighbouring battle-field. It is a fair inference that he was an Englishman, and that he was not the only one waiting for peaceful times to exercise the cunning of his hand, and to learn from happier foreigners, who always had surer appreciation and encouragement. I forget whether it is said what was in the bottles contained in the box. That all Low Country painters in Vandyck's time had adopted drying oil with mastic is denied by the story told, more than a century later, by a Fleming to one Fairfield, that copal was the medium of Cuyp. The practice of the time of Vandyck was substantially continued by all the big-wig portraitists till the revival of painting in England. No new system was introduced. The history dies out like a grand river in a fetid marsh. We will now, therefore, go back to speak of the results as shown by the state of the paintings. I will afterwards sketch the history of the modern practice, and examine its consequences, this will afford us a due means of comparison of the degree of wisdom in the system we rely upon, which dates from the early part of the last century. I would here only point out that great middle-aged art, ending its days throughout Europe, enriched by painting of gods and goddesses, and lords and ladies, under and over-dressed in finery, inflated in its incompetence, divided its heritage of work, leaving the use of the materials only to its ambitious sons, discarding the preparation of these, as though grudging the necessary price of safety, and that the course then chosen we have ever since been too inert to reject.

On taking a retrospective survey of painting, from the days when the process called oil-painting was first invented by the Van Eycks, the most remarkable fact that arrests our attention is that the earliest works are still the brightest as to light and the strongest in colour, the most ambitious in these particulars originally, and the best preserved in white and colour to this day. A magnifying glass reveals no defect in the ground, beyond the existence of some minute cracks, caused apparently by the dilation and contraction of the wood or the canvas, which has caused the enamelled surface to form itself into separate but closely adjacent and fitting parts, like the surfaces divided on a crackle jar. The most precarious of colours, the brightest green, and even the yellows, inclining to dandelion tint, are perfectly preserved; and these are the most unstable of all pigments in this day. I remember a picture in the Uffizi, by the Bellini school—if not by the father of the Venetian school—where this last-named most rarely secure variety of colour, though not of the intensest, is of beautiful pure character, and as unchanged as on the day the picture left the artist's studio, The Van Eyck in our National Gallery will tell of the green, as it will also, in the brass work, testify to the perfection of the tint called now lemon yellow. It is needless to single out pictures with examples of perfect blues, for nearly every *quattro cento* painting has these; some distinctly painted with ultramarine, but others of a more steel-tarnished tint, which, in these days, would require Prussian or Antwerp blue. Of crimsons there is every variety in perfection. Of purples there are but few examples. Purple was not often used by the old masters; a warm tone of this is in the vest of the standing up figure in the "Adoration of the Magi," called Giorgione in our Gallery; another is in a portrait, by Titian, at Temple Newsome. Our unfinished Michael Angelo will convince us that they knew perfectly how to make the most precious tint of vermilion—the orange tone—permanent; and many other pictures in our collection in Trafalgar-square will prove the perfection of durability of other shades of cinnabars. In the "Vision of Ezekiel," by Raffaelle, in the Uffizi, the sky is painted with an intense lemon yellow, which has no taint of failing in it. The "Bacchus and Ariadne" will show many triumphs in dealing with difficult pigments, in addition to the staunch quality of the orpiment

on the scarf of the nymph with the cymbals. The greens of the vegetation are of a stronger colour than we find in most of Titian's landscapes, although not anywhere so remarkable as an exquisite apple green used by him on the sleeve of the Virgin in a picture of the "Madonna and Child" at Munich. The Veronese of "The Consecration of St. Nicholas," in our National Gallery, although terribly ruined by a wash of some dark decoction administered by the dealer at the beginning of this century (because, before, it was refused by purchasers as too bright for their perfect taste), still shows the vestiges of a strong green, managed most artistically and with perfect mechanical success. Tintoretto's "St. George and the Dragon" gives the blue-like steel tarnish, of which he used so much. Many of his pictures give purple lake still without change. His pictures at San Rocca have lost some of their original richness, from the desiccation of the varnish, and mildew caused by exposure to damp, to which they were more sensitive (I am inclined to think) from having been commenced in tempera on paste grounds. The aim was gradually becoming less to obtain the unsullied purity and brightness, than to develop all the lower harmonies of light and colour; but, in the fewer points where brightness was sought, the power to produce and to retain fulness is only less remarkable. Many examples of Italian art of later date might be adduced to prove that the traditions of practice had not been lost; the testimony to the wisdom of these carefully preserved habits could scarcely be strengthened by further instances of good management by the painters.

We will, therefore, proceed to the northern schools, in which a taste for colour was still unsatiated. Rembrandt and Rubens both relied upon the stability of their colours, in a sense of which it could not be said of poor Andrea del Sarto, either at his worst or at his immeasurably distant best. In the first-named of the Low Country painters there is no intensity, but every tint now appears to be exactly what the artist, after consummate self-culture, and due reflection and balancing for the particular object, had determined it should remain. In the exquisite portrait of himself in our gallery—painted, probably, with simple earths mixed with white and perhaps a little Naples yellow—there are touches of tempered vermilion on the eyes which would suggest that this had been put on cautiously in a final glaze; but, in the portrait of a child at Kensington, once said to have been a portrait of our William III., there is a rich paste of luscious colour in which vermilion assuredly forms part. In portraits by Rubens it is impossible to be mistaken in identifying this colour mixed with white, in which condition it is said to be most tried. A friend, after a visit to Belgium, once remarked to me, that the mixture of vermilion in the flesh by Rubens endures so perfectly that it is a misfortune to this florid master's reputation. When, however, used as in the "Chapeau de Poile," it can only make us envy the painter, as it does also in the portrait No. 54, in the last old-master exhibition at Burlington-house, lent by Earl Sidney. The portrait of Gervartius, by Vandyck, was said to have been carried about by Vandyck in his colour-box, as an example of the ability of the painter; it remains now as a proof of the great mastery he had, not only in art, but in the mechanical skill over the materials with which he worked; for no picture could be in a more perfect state, either as to colour, texture, or freedom from marks of disintegration of any kind. The "Paul de Hooge," in our National Gallery, painted in 1658, is clear as a *quattro cento* work, and is conclusive as to the safety of mixing orange vermilion with white.

As our consideration of the consequences of the modern system will mainly seek for enlightenment by reference to pictures painted and retained in England, it will not be wasting the few necessary minutes to see whether the peculiar climate under which we live has ruinous influence upon old oil paintings. It can be proved best by going back to what is, probably, the earliest cabinet painting existing of native produce. It is a triptych portrait of Richard II., with attendant angels, painted necessarily in England. It was exhibited in the Manchester Exhibition of 1857, by the kindness of Lord Pembroke. This painting is not in oil, but the ground for all kinds of panel pictures was, at first, the same for oil or tempera; and so it is in the preparation of the wood or canvas on which a painting is executed that its stability most depends; it is not beside our mark to notice that our climate has dealt as kindly with it as that of any other country would have done. The picture referred to, with the portrait picture by Mabuse, said to be the children of Henry VII., —but which Mr. Scharf proves to be the children of the King of Denmark—which came next in order of time, and the court portraits by Holbein, which followed, and those by Antonio More, bring us, with a dark leap, again to Rubens and Vandyck; and, even though a few pictures—where mistakes in the priming were made, or accidents had happened—may have suffered damage, there can be no hesitation in deciding that the system by which the painters of these pictures supplied the materials for their work, and managed these in their art, left nothing to be desired. The picture of "Peace and War" was painted in this country. In examining the surface attentively, one may hammer out a page of the history of the embassage which Rubens was engaged upon, by noting that odd-sized pieces of cloth have been joined together to make up the full measure of the composition. Had it not been a sudden inspiration to propitiate the king, it is probable that Rubens would have procured better canvas from home. The ground, moreover, has not been scientifically manipulated, for it is now seamed all over, in a manner which speaks of more than the poorness of the canvas, as well as of rough treatment subsequently. This cracking here is from below, not from above. The "Brazen Serpent" tells of more deliberate choice in materials. The cloth is in one strong piece, and accordingly the painting is in much sounder condition.

In leaving the evidence which the pictures by the old masters afford of the excellence of the system they adopted, it is edifying to reflect upon their comparative poverty in pigments, when ranging in brightness or depth, beyond the simple earths. The early Florentine painters had for blue, after the perfect one, ultramarine, *biadetto*, known now as *verditer*, a German or Hungarian natural mineral, and indigo. For yellows they had massicot, and, for the orangy tint, orpiment—both

of which are treacherous in unscientific hands; they had Naples yellow, which has since been discarded as undeserving of confidence, and gamboge, which is now scarcely looked upon as a pigment suitable for oil. For reds, they had a crimson made from Brazil wood, and the colour called dragon's blood; also purple lake—now distrusted—orange lead, vermilion, and a red earth, of superior brightness, called hematite, or sinopia. For greens, they had verdigris and a second copper-like emerald-green, neither of which need now, for mixed tints, be tried by the boldest of colourists. A purple tint, made by crushing amethysts, appears also in the list. In other parts of Europe, as a dye, a crimson existed of the most invaluable strength and permanence, called Kermes. Chaucer speaks of it as a rich dye in England, and many *cinque-cento* retailers of craft secrets give the means of extracting it from cloth for painting purposes; and the Venetians early seem to have used the colour in oil. Madder was also in requisition for painting; but these two precious crimsons were both driven out by cochineal, which retained its unmerited supremacy in the colour-box until the beginning of this century, when madder again appeared. Kermes has not yet revived in a form for use in oil, although, by the enterprise of Mr. William Morris, it has now been introduced for dyeing purposes; and, by his kindness, I am able this evening to show you a specimen of the "grana" of Portugal. In addition to these pigments, there was asphaltum, which first appears in Titian's time; and there are records of colours made from flowers—yellow from crocuses, purple from violets, and a crimson from ivy juice, which gave us our name lake. If these further colours were an addition to their store, and were adopted by the great old masters, the skill which enabled them to produce so good and lasting an effect with them deserves further admiration; and their use gives a further reason for admiring the perfect practical skill of the old masters in contending with the difficulties of management of materials offering themselves for use in the process, which alone allows us the opportunity of exercising our art in its fulness.

If ever there was a time in which the sequel was to prove native worth deserved to have a good system to commence its art with, it was in England, when Hogarth and art together were growing into a national power, and when Reynolds and Gainsborough were gathering their life-long store of impressions of human lovableness, which, registered in adult years, made the authors superior to any predecessors in sway over minds capable of love springing from a pure heart.

> "Will fortune never come with both hands full
> But write her fair words still in foulest letters?"

In George the Second's time, she was most unevenly furnished. In one hand was the blessing of every high gift and genius in art short of sublimity. It is no exaggeration to say this of a school which produced, after the first great painter of manners, Reynolds, Gainsborough, Romney, Lawrence, Stothard, Wilkie, Turner, and Leslie. Fortune cannot give what she never had committed to her keeping. The traditions and the practical skill—which, as we have seen, the old masters husbanded as the price to be paid for the safety of their creations—had been thrown away by the previous generation as too troublesome to keep; and so the second hand had no gift for new English art.

To explain the fact in detail, let me remind you that the resuscitation of painting which came in George II.'s time—mainly by the clear-mindedness of the great Hogarth—did not awaken any thought of the need of the old cunning in preparation of materials, for the means had been provided to save painters from some of the labour which, before, it was their duty and their pride to undertake in their workshops. The gain was palpable, the loss not immediately so. Sir G. Kneller had set up his old servant as artist-colourman in London. He was (so history says) the first of the kind. The change in system did not, however, depend upon this mere accident. It was, probably, effected slowly. The suppliers of raw materials must have undertaken to get these made up, to grind the colours, to provide the frameworks, the stretchers, to prepare and strain the canvases, and to make up the brushes. It was, even then, with the increasing taxes of modern life, an inevitable alteration, as is proved by the fact that it was made in other countries as much as in our own. At first, however, this delegation of the mechanical work to another person did not lead the artist utterly to abdicate his own authority; for knowledge of, and preference for, certain systems still remained with the painter, and the colourman would, therefore, have received the traditions of the painter's workshop from each and all members of the profession, and carried out instructions as the servants would have done earlier. The special secrets were handed to the tradesman, very much as the prescriptions of a physician are confided to a chemist. Each painter must have given exact directions as to his favourite manner of preparing a ground, of his mode of clarifying oils, of ripening these, of making varnishes. He must have insisted on the due degree of levigation of coarse colours, and intimated his choice of oils with which the different colours should be ground; and, if compound tints were prepared, these—it is still traceable—received the names of the artists who first ordered them. Indeed, no great difference was made in the degree of control exercised by the painter, under this new system, until the generation which had begun their careers, while pupils, as practical artist-colourmen to their masters, had died out. Then, traditions remained as curiosities, retained always longer and more accurately when the sons followed the fathers in the art, and, of course, at times made tangible knowledge—instead of mere verbal wonders—when, in what were considered idle moments, an eccentric practitioner made experiment of some almost incredible tradition of ancient practice. A few such traditions I myself, when a boy, received in the teaching of a painter who was an art descendant of Sir Joshua Reynolds (these were of vehicles other than the mixture of drying oil and mastic varnish then universally in use; one was of wax, the other a curious combination of water beaten with linseed oil into a jelly; many better legends, well worth examination, may still be in the minds of elder members of the profession), but the real skill of the workshop was handed over to the tradesman, and all practical knowledge

held by the painter, of the means by which the canvas and the colours were got ready to take their places in the studio, was doomed before modern European schools began. At first, the colourmen must have had many reasons to respect and to satisfy the knowledge of the painters. It is better to be tautological than not to make quite clear that, although Hogarth inherited not the science and ability to do his own mechanical work, he received materials from tradesmen who had not made new inventions, either for good or for bad, but who worked on the directions of painters who had watched the canvases of their masters, and had heard from them the result of their own teachings and observations—going back, through generations, to the root of art. While nothing had been added, however, something had been lost; for the tempera ground had disappeared, which was the delight of the Florentines and Venetians, when painting pictures that have best retained their purity, and which, as you will see by examination of the ground revealed by a small broken blister on the landscape called "Rubens' Chateau," the great Flemish master used. All the last century English pictures seem to have been painted on grounds prepared, as now, with white lead over a coat of size. Vasari recommends such, and the safety of his works disproves a contemporary declaration that they were not sound. The want of brilliancy in his productions is due, perhaps, only to the fact that the grounds were dark in tone, and the use of much umber with the white may also be the main reason that no Georgian pictures vie in vividness with those painted three centuries earlier; pure white lead, as a ground, is perhaps worthy of comparison with gesso, but it has not so long and certain a testimony to recommend it, and a proved advantage four centuries old should not be lost. The main principle of painting, too, was a very different one from that which had gained such favour throughout Europe, for varnish painting was almost, if not quite, lost; it required a familiar knowledge of each colour, and this had gone. To use colours with oil alone for very simple aims may have its recommendations, but no strong or bright colours can be thus retained. Where design alone, or the merest suggestiveness of treatment, is the object, perfectly purified and well ripened oil may be a good vehicle. I think we can safely adduce most of Morland's characteristic works as fair examples of the kind of texture, quality, and effect oil alone will produce; some early portraits of his are certainly, however, with a varnish medium. One good picture by him, at South Kensington, is evidently with oil varnish. Hogarth's are, I think, painted with the better preservative, thickened oil, or oil and mastic varnish mixed, which, in fact, makes mastic an oil varnish diluted with turpentine. As a spirit varnish it is often most mischievous. The earliest pictures by Sir J. Reynolds are painted, apparently, simply with oil, and, although the colour is of the most modest character, and the painting altogether without indication of that love of *impasto* and richness which his maturer pictures have; they are in such beautiful order, that one is tempted to wish that he had never gone further afield and fared worse, as he did, to our great misfortune—so terribly, that in many cases the sight of the original of a subject dear to us from familiar prints is, with its gaping fissures, its lost colour, and its avalanche of background, descending on to the very core of the picture, a cause of serious pain. My audience here are well able to judge of the unambitious character of the system Reynolds, at his first start with others, adopted, 120 years ago, for the very meritorious designs by Barry around this lecture-room are probably painted with oil alone. They are certainly not of Van Eyck's method. The painter who had no love of strong effect, and who wished to avoid a shining surface, had reason for this choice. The system has its merits; one being that work done thus, if otherwise simple, does not crack. On the other hand, colours made from lead are quickly oxidised by impure air, and colours of the slightest flightiness of disposition, if unprotected by varnish, soon fade or change; and the adding of varnish is often so ignorantly done, that it is more often a cause of ruin than of good to a picture.

The paintings around us have been left to the care of the oil alone, and if the spectators will make the effort to imagine a Bellini, a Titian, a Rembrandt, or a Vandyck hung by these works, he will at once see how much Barry lost by his house-painting system, and what was Reynolds's inducement to seek means of painting more like those of the first painters. There are two canvases in existence, recently purchased by the Royal Academy, on which Reynolds made several experiments with colours—those particularly of an evanescent character; gamboge, carmine, and green mixed simply with oils, and again with varnish and wax. His handwriting certifies to the nature of the combinations. Its results are interesting and profitable for consideration, but its first important value to us is to show how eager he was to obtain a sure method, and how entirely he was destitute of sure information from the experience of his predecessors as to a means of work with a richer and fuller medium, without which he could not exhibit powers, to make himself, as a painter, Rembrandt's equal, at the latter's own best. This was, probably, the only preliminary trial that he made of wax before beginning to use it for his pictures. He used asphaltum because he had had good evidence that the Venetians adopted it safely, but he had not had experiments of generations to show him the course of safety with this and other luscious compounds, and it is owing to this, alas, that many of his pictures are now only ruins. He had had to begin anew, and without any experience of the practical drilling in the handling of materials with which Van Eyck commenced his researches. Doubtless, he learnt much by the end of his life, as all painters do; but no real system existed by which this could be handed down to his successors, and so when the last weariness came to his eyes and cultivated hand, nothing but records of fragmentary experiments remained. These two canvases offer more to attest his endeavours to save others the darkness in which he had begun, and for our information, than all his paintings do, for a disappointing tint on a picture affords us no means of ascertaining its original value. The pity is that a complete set of experiments with explanatory notes was not made at this date.

Gainsborough painted with colour and medium,

much diluted with turpentine; the vehicle was evidently made with a large proportion of mastic varnish. The colour has been well preserved in all cases where much cleaning has not scarified the delicate surface. The thinness of the paint has prevented extensive cracking. Had the result, however, been a perfectly durable one, notwithstanding great beauty, the effect is too like that produced by water-colour to be quite satisfactory in large paintings. In pursuing the evidence of the practice of the modern school, I shall not make a point of pursuing extraneous evidence alone, but shall, as seems more fitting for the shorter term with which we have to deal, feel free to mix up the testimony from records by painters of practice, and that which the works afford, with observations on the result. Wilson's pictures always seem to have been painted in a simple manner. Asphaltum, with its slimy surface, I cannot remember in any of his paintings, and its absence alone would greatly account for his success in escaping cracking. Turner's early pictures were painted much like Wilson's. At the end of the last century, young artists, in consequence of the great war, were unable to travel in Italy, and the purchasers of pictures were so few, that scarcely any but portrait painters could get the barest living; the two causes combined to make them less inclined to make researches for improved means and materials to those at hand. The taste which Reynolds had established for a fatter medium, and other luscious additions to the palette, was indulged without restraint, because the evil consequences of his system were not seen by the first, or even the second, generation; indeed, paintings of his, of a very unsound character, which have been hung on a wall of a favourable nature as to freedom from excessive changes of temperature, great heat from stoves, or from ignorant varnishing or cleanings, are still in such a good state, that none but a suspicious spectator could trace the inevitable destruction which awaits them. "Simplicity," I am happy to testify, appears free from any serious danger. It seems as sound as any canvas painted in Holland 150 years earlier, and this fact gives hopes that some of his other pictures may carry his claim to posterity as a painter, as well as an incomparable designer of childish and womanly grace. The escape from early evidence of evil from the lavish use of asphaltum, betrayed many less important workers into the snare. Hilton, and more lamentably Wilkie, both adopted this Dead Sea product from the beginning to the end of their careers. Indeed, in their generation, the use of this pitch was almost universal. Constable never had a great affection for it, and at the end of his life he evidently discarded it altogether, although modern fabricators of his paintings use much of it, and the disgraceful dealers in such frauds get them more easily accepted as genuine. Etty, in his latter days, used it but sparingly. Mulready, when past seventy, told me that he did sketches with it at one painting in his early days which had never cracked. Turner never manifested an established taste for it. He did sometimes enrich his darks with it, to doom them in the end. At times, too, he seems to have sketched his general effects with this stuff, which undeniably at first gives a most fascinating tint alone, or with white. Maclise and Landseer were, with others of their time, seduced into its use. The misfortune was greater, because all of these painters had such a passion for the rich tint it gave on a white ground, that they never began their paintings without it. This use of it as a foundation was, I believe, the great difference of their practice to that of the old masters. The Venetian and Low Country painters commenced their works with solid ochres and umbers and whites, and when they luxuriated in asphaltum it was to serve as an overcoat, which could move about, if it would do so, without damage to the foundation. I believe also that the nature of the gesso ground had much to do with its safety on old works, the oil ground, without doubt, causes here, as with other colours, the evil which Dr. Liebreich deplores in modern work, the non-drying of the under ground before the next is added, but if it were necessary to recur to the use of asphaltum now—which I am glad to declare it is not—it would be worth while to try whether its vitality could not be burned out of it, and it might not then be used with impunity. Its use from the great revival of Art in England to the early days of this generation of painters was such a prolific cause of ruin to the works executed during the period, that it deserves deliberate condemnation as a sure provoker of punishment. There were other sources of evil which have to be inquired into. But it seems better to defer examination of these until we have concluded the history of the changes in English practice. One important fact in its influence upon modern work was the publication of various essays in the "Transactions" of this Society by Mr. Sheldrake, written in 1791 and 1801, on the use of amber and copal varnish in the place of the weaker medium then in vogue. He proved that these were the favourite vehicles of the Venetians, and experiments that he had made proved the much greater power these varnishes had in preserving colours than simple oil or mastic, or these mixed together. Respect for this view spread; and accordingly, in the course of the following years, several young painters were induced to adopt these stronger varnishes as guardians to their colours. Mulready and Creswick were among the number—although the latter subsequently discarded it, as less handy than the medium ready in tubes. Two others, whom I am happy to speak of as still living, can give testimony to their satisfaction with it for about sixty years. I allude to Mr. Linnell and Mr. Webster, whose pictures, with those of the others mentioned, now give us long proof of the justice of the conclusions arrived at by Mr. Sheldrake. Another change came about by the scientific researches of the French Academy, who published Merimée's book, who supplied us with French ultramarine, and revived the manufacture of madders. The labours of Mr. George Field, a chemist, who applied himself with great assiduity to his task, much improved the range and the beauty of the colours to choose from. His madders were far superior in strength to those which preceded them. His lemon-yellow was believed to be a perfectly permanent dandelion-tinted pigment, destined to entirely supplant the light chrome. Cadmium was a perfect substitute for orpiment and orange chrome, and his orange-vermilion won so good a reputation that the tint is still always sold

with his name as its best recommendation. His preparations of genuine ultramarine were so valuable that, after his death, the little store left in the hands of colourmen went up to a premium in price, as did also his vermilion to a still greater extent. A year or so before his death, wishing to have some lemon-yellow direct from his hands, a friend of mine kindly consented to visit him, with excuses that I could not come myself, and an explanation of my desire. The old gentlemen was quite affected by the appreciation of his labours which the direct application betokened, and he confessed to feeling aggrieved that he had so few signs from artists themselves of their approval of the value of his labours. He explained that the manipulation of the vermilion had cost him so much time, and that it was so thoroughly an invention, that he had applied to Government and to learned bodies for an award of £100 in return for the mode of preparation, which not one had consented to give. He declared that he would not part with it for less, and I believe he carried his secret with him to the grave. The pictures of forty, thirty, and twenty years ago gained the advantage of this careful chemist's scientific labours, for the colourmen were discriminating enough to value the products of his laboratory, and the artists, without care, were fortunate enough to be supplied with what now would be above price. Other colours also appeared at this time, perhaps from independent channels—the two oxides of chromium, purple madder, and the yellow madders. The painting of the Houses of Parliament, and the preliminary interest which awakened the thirst for knowledge about the practices of the old masters, resulted in the publication of important books, which have not yet done all their good work. The loss of Field's secret was greater to art than at the time it was known to be; for, as we shall see, the character of the vermilion which in this day goes by his name, is in some cases disgracefully inferior, and in no case is there reason to think that his invention has been rediscovered. His lemon-yellow, too, has never since been equalled in any degree; indeed, the colour now called by this name is so inferior, that there can be no question that common No. 1 chrome yellow is much to be preferred.

Deep cadmium had deservedly gained a high reputation, but the introduction of some lighter tints of a treacherous kind—if not, indeed, the discovery that the stronger tints have also become variable in trustworthiness—has established a just feeling of caution towards all varieties. But we have to bring up the history in other points to the present day.

The introduction of copal and amber varnish was not regarded by all painters as suitable to their own habits. The varnish as presented was too viscous a medium for those who had got accustomed to megilp; and the colourmen, to meet their wishes, introduced secret preparations of their own compounding, which were recommended as possessing the advantages of either. On the Continent, similar patent combinations have been introduced. The fact marks the change of practice. In old days the secrets were the artist's; now, he is the first to be kept in ignorance of what he is using. As to canvases, the aim has been to increase the smoothness of the surface. This ivory texture, for many purposes, is a great merit. The colourmen have had the whole responsibility of deciding how to secure this desideratum—as, indeed, they have to satisfy all other wants—and they have been convinced that a cloth of the lightest character can most conveniently be made regular in thread, and that this can be best prepared with a ground of the required delicacy. The success of this experiment has encouraged the putting aside of strong ship-sail canvas, which at one time, we shall see, was often used.

In the necessity of now examining the misfortunes of our system, I feel called upon to avow that I regard the artists' colourmen of London as gentlemen of intelligence, of character, and great enterprise, to which qualities we are much indebted for the comparatively safe position we enjoy; for, indeed, at the worst, it must be recognised that we might have gone much further astray. It is needful, however, that we should be not only in good hands, but we should give strong proof that we can distinguish between that which is faulty and that which is perfect; and it is the want of discriminating power in the painter which produces all the indifference on the part of the preparer to the permanent character of the materials he supplies. The painter has really not the power to trace the causes of defects. The colourman naturally judges of the character of the materials he vends by the condition they are in while under his own eye. To him, the evils revealing themselves in the work which has passed through his shop do not exist if he never sees them; and, if he hears of them only, as evils untraceable in their cause which have occurred to one of his customers (who may, sometimes, have obtained materials elsewhere), his sense of responsibility is quieted, when he has received the assurance of his men in the workshop that the usual rules, which have hitherto resulted in work of a kind not eliciting complaints, have been strictly adhered to. The workmen, too, in these shops are not permanent, and there is virtually no responsibility for any one preparation. In most cases the complaint is never made, for the evil may be a very serious one, and yet it may not manifest itself before the death of the artist. In one artist-colour establishment in London alone are colours extracted from their roots; and even there certain colours are purchased from wholesale makers, who are without the feeling of personal pride in the perfection of their products which Mr. Field and the Dutch preparer of vermilion had. The other establishments buy from the wholesale supplier, and thus the user of the colour is so far away from the maker, that there is no real communication between them. So thoroughly is this accepted as proper, that I have been refused both tubes and colours when I have sent for them, the apology being that it did not seem fair to sell direct to the artist. Let us now, by special cases, see how the system works.

Twenty years ago, wanting to have a painting enlarged, I went to a colourman of the best standing, and asked him to explain to me the different systems by which such changes were effected; and he told me that sewing the extra pieces on, as the old masters did, was now found to be quite unnecessary. It caused a great eyesore in the picture, and was no additional source of strength. For

many years they had undertaken the enlargement of paintings for Maclise and Landseer, who had been greatly pleased with the manner adopted of relining the central picture on a canvas of the required dimensions, and then fastening down with glue the marginal pieces. I saw specimens of this ingenious treatment of paintings which, in progress, had outgrown their original conception, and nothing could be more satisfactory to the artists' colourman point of view of a few years; but a visit in this day to Maclise's "Play Scene in Hamlet," and to Landseer's "Field of Waterloo," will at once reveal what a mischievous point of view this is; for the two edges of the adjoining canvas have curled up, and opening lines, every day getting greater, mark the original confines of the composition. This is, in the one case, twenty, in the other thirty years—a time almost out of consideration, by its length, to the tradesman; but it should be a mere to-morrow to the painter, whose work is not worth the doing—to any one but his humbled self—if it will not last for many generations of eyes and minds. The mischief which we have to cure is like a terrible growth requiring the surgeon's knife. We English people are not given to hiding our own weakness; we attribute our vitality to our habit of being the first to speak of our defects; and the rule should certainly not be abandoned in Art matters. I will, therefore, illustrate the weakness of our system by another case. It is now thirty years since that I bought a canvas from the same most respectable house, where before and since I have obtained many excellent canvases. The one I speak of was remarkably sandy in texture; it was so far objectionable in this respect that, after the first two or three days' painting, I should have changed it for another, but I was in the country; and I contented myself by spreading with the palette-knife a filling-up couch of zinc white—then just newly introduced—on the part where my principal work would be. The picture was eventually finished, and for ten years I had no suspicion of its malady. At that time I had my attention drawn to a number of minute particles on the surface of the painting. On experiment, these proved to be microscopic blisters, which, when scraped away, left the white canvas exposed. There must have been 5,000 in the space of two or three square feet. A couple of days' tedious and careful stippling remedied the injury; but, in another ten years, a similar and almost as numerous a crop appeared, with the like need of retouching, which has, in later years, even again occurred. The late John Phillip told me that he had had the same mishap with canvases purchased in Spain, and he had ascertained that the ground had been prepared with sugar of lead as a dryer, and that the mischief would go on until all the particles had come away. I invited my colourman to explain to me the reason of the mischief, telling him the details of my treatment of the canvas while painting. He jumped at the theory that it was the zinc which was in process of disintegration; but this, as I could show him by tracing the greater smoothness of the canvas where I had applied the white, could not be maintained, because the particles had not broken through at all in that part (perhaps, from the greater thickness of the paint, they had escaped through the back). The fact was, I was altogether wasting time to ask this gentlemen any questions about the canvas, which, probably, if prepared on his premises at all—and this, as it happens, is very doubtful—had been trowelled by a workman who never expected to see that canvas or hear of it again one week after he had taken it off the stretching frame. I know of another painting executed on canvas, bought at the same time, and the same shop, which has gone through the same history as mine did; and a third canvas, from the same establishment, had part of its ground peel off like a sheet of paper while the painting was in progress, entirely destroying the artist's labour. I have also had experience of canvas which, if worked at in one intention from the beginning to the end, has proved perfectly equal to the work, but which on any scraping out and corrections has had its ground broken up into facets, on account of the weakness of the cloth; and this has caused obstacles to the happy termination of the work of the most serious kind. I have brought specimens of canvas here, as well as of experiments with colours, which it will be profitable to examine at the end of the meeting; but the best test of the effects of our system will be in the state of the pictures of the English school which are at hand in the National Gallery.

The first paintings which claim our attention are naturally those by Hogarth. Thirty years ago, they were as sound as when first put into their frames; the simple and honest character of the mode of painting adopted had kept them in excellent order. The painter, in parting with them to the purchaser, had begged that he himself only should be allowed to varnish them, when this was wanted; so it is certain that he took all pains in their execution to guard them from danger. Unfortunately, about twenty years since, they had to be removed to Marlborough-house and to South Kensington, where, with hot air blown over the surfaces of the pictures, from pipes since changed, but then placed immediately below them, they were being treated like dishes rather than pictures. The "Bagnio Scene" is the most damaged, for serious cracks, threatening further movement, have revealed themselves, of a kind that seemed quite foreign to the character of the works. These, unless coming from some hidden use of asphaltum, traceable in no other indication, neither the painter nor his colourman are responsible for. The defects of Sir Joshua's pictures, beyond those already referred to, come from the use of cochineal lakes and carmines in the place of the sound kermes and madder lake, and of orpiment in flesh instead of the eternal Naples yellow, which all the old masters used with such perfect success. A lavish use of wax on an unsuitable ground was, perhaps, a further cause of evil. One valuable picture, the portrait of Dr. Johnson, worthy to compare with any portrait of manly character in the whole collection, is, except in a certain lowering of the whites, in admirable state.

There are two works by Sir T. Lawrence which illustrate a consideration of great importance that has never received due attention in our time, and that is the difference of durability of a painting on a good or a bad cloth. The portrait of Mrs. Siddons is on a flimsy material, that would scarcely suit for even a small painting, and so the whole canvas is mapped out into seams, dividing all the work as though it were in preparation to turn it into a dis-

secting puzzle. The divisions, which will every day become worse from the dilation and contraction of the canvas, come from below, and not from above, and are proofs of want of wisdom in the choice of canvas. The portrait of B. West, on the other hand, is on a sturdy, firm cloth, and, except in one point, where, from a blow, the coat of paint has scaled off, the picture is entirely well preserved. Having studied the difference of these two, I will now give you a list of pictures by Turner, painted on bad canvas. "Richmond Hill," seamed in sky and water. (More here, because the white used has made the body like porcelain, the pigments used for the deep colours from earths, &c., being more pliant.) "The Decline of Carthage," which is worse, from having been taken off its original strainer and made larger by six inches at the bottom, the painting, in the process, having probably been shaken and twisted by careless and ignorant workpeople. "Orvieto," which is much cracked in parts where it is greatly loaded. "Heidelberg Castle" and "Childe Harold's Pilgrimage," both seamed in ground; the latter, in addition to being mapped over in general lines, being cracked on the inner lines of the stretching-frame on both edges of the cross piece, and also staved from blows given behind and from shaking, a very small proportion of which damage would have thus shown had the canvas been a stout one. This will be at once understood by observing the pictures on good canvas. The "Dido" is one of these, which is sound except where asphaltum has been used. "The Calais Pier" and "The Shipwreck" are both on good sail-cloth, and they, being otherwise wisely painted, are as sound as when first put aside; "The Tenth Plague" defies cavil, and the "Dido and Æneas" is only cracked in impasto from other causes, probably from too great haste in loading, for the "Ulysses Deriding Polyphemus," being on good canvas, is much loaded but not cracked. It will help us to see how important it is to have the ground as firm as possible, if we look at works by the same master and of the same date on panel, which, in respect to unfluctuation, should be perfect. "Windsor," "St. Maur's," and "The Approach to Venice" are, while the wood is unsplit, in no danger of damage from below. Some of these are cracked in slight impasto, which raises the question whether the panel was duly seasoned. I feel that the study of pictures of past days, for the mechanical science of painting, so soon brings one to the recognition of the importance of the choice of canvas, that I will venture to interrupt my scrutiny of the Turners to point out that Rembrandt's painting of "Christ Blessing Little Children" is, for an old master, on exceptionally bad canvas, with diagonal lines of fracture that seem to be following lines of a large diaper pattern. Claude's "Isaac and Rebecca" is also damaged in ground; but the mischief may not be the result of a bad choice of canvas, only of the want of a panel-back to the cloth, and of carelessness—much too common in people who ought to know better—in the handling of the picture. Some of Turner's pictures suggest other lessons. The "Hoar Frost" is cracked all over in the sky, and is re-opening in lines once filled up. The evil is very like one which has come to a sky of a picture which, thirty-four years ago, I, by mistake, painted with salad oil, and which, three weeks afterwards, to expedite its drying, I touched into with the medium called Megilp. Careful records of experience would offer the hope that the secret cause of such disaster as this to Turner's picture would be discovered—would that it had been before the painter commenced to paint this delightful picture! A curious fact, deserving inquiry, it is to see that, in many of Turner's, the blue sky is altogether uncracked, except from bad canvas, while the warm lights are chequered with a network of openings. To one picture I will again call your attention, in parting from Turner. It is "The Approach to Venice," exhibited in the year 1843. The sky is enriched with bright primrose yellow, a tone of colour much aimed at by the painter about his first period. It is, perhaps, the only work in which this tint is unpolluted, and in this it is perfectly pure. In other pictures it has gone to a brassy hue. Earlier, he used chrome—not such a bad colour as it is said to be. You will find, from experiments I have here, that there is no lemon yellow at this day on sale which will keep its pristine clearness for a month; none so well as chrome. The yellow in Turner's "Approach to Venice" you will recognise as Field's lemon yellow, and, so it is a justification of the maker's boast that it was absolutely permanent, and being so, we have good assurance that it is only necessary to appeal to the science of the present day to obtain this beautiful colour again. Of Field's vermilion mixed with white we may find many examples in Mulready's pictures, who seemed rarely to use any other colour for flesh. I think I have said before that chemists have decided that, theoretically, there would be a difficulty in preventing the bi-sulphuret of mercury from being affected by the lead; it is important, therefore, to find an example, in modern days, of practical superiority to this danger. When the chemical change has not occurred in thirty years, I apprehend that the combination is not likely to bear evil consequences. On some of my canvases you will see an example of the two colours of later make combined. Much more of value, as to the state of the pictures of the English school, may be gathered by further scrutiny.

On turning to our trial canvases, we will first continue to pursue the question of colours. No. 1 canvas you will, I think, agree to be instructive. It was prepared in the year 1860, and, as it hung up in my studio, a few colours were added in the five following years. The first specimens I have bracketed together, as being all lighter than the prepared ground of the canvas. White, Naples yellow, are still so, but Strontian yellow and Lemon yellow (called Field's) have deteriorated to a much darker shade; the first—besides being neutralised to a pitch which makes it scarcely a colour at all—has little shades of a reddish hue spattered about it. The other is, you will see, very much inferior to the chrome yellow below it, which was put on at the same time—this pigment I remember the late Mr. Charles Leslie, a true colourist, always preferred to any newer substitute. There are indications that one cause of mischief is the bad quality of the oil with which it is mixed, for where this is absorbed the lemon yellow is much brighter, so that it is doubtful whether the lemon yellow was really at fault.

Full-toned cadmium is not darkened, but it is unlustrous, and like straw instead of marigolds; but this black patch below was at first a buttercup colour, called light cadmium. Extract of vermilion is the next notable colour, which is in a doleful condition; Chinese vermilion, so called, not in very bad condition. At the bottom of each patch of colour I have rubbed up a portion of it with copal, which has always somewhat preserved the tint, but it is evident that in some cases more varnish was needed for such poor colours. Madder carmine is remarkably perfect and beautiful; Indian lake is good. Yellow Ochre, Red Siena, and Burnt Siena, of which each has different examples, are nowhere good.

In the next range, we come to an example of a well-known misalliance, cadmium and emerald green. When put on, the tint was brighter than this at the side. It is now as it was within two weeks of its first application—nearly black. The grass-green neighbour is No. 1 chrome and emerald green, and it is entirely without varnish. The three chromes stand near, and are all remarkably good. Mixture with white has preserved the the lemon-yellow above, and here white does no mischief. Emerald green alone has gone to a deeper tint, but Veronese green is quite bright and clear. Prussian and Antwerp blue have lost all their beauty, not having a tinge of the loveliness which, for example, Tintoretto's blue has in "St. George and the Dragon." There is a tint here which was honestly sold as untrustworthy. It was, I think, called violet carmine. It has now but little colour, although some depth. At the edge of the canvas is a darkened spot. I had been told that fat oil was an excellent medium by Mr. Dyce, a painter whose great genius made him deserve the best that could be obtained. I obtained some, and tried it here; for twenty years it has remained wet. Any gentleman can prove it by touching it with his finger, although it now ought almost to have been wiped off by experiments. I do not pretend to decide from this that fat oil is always thus with colours. The next canvas was prepared in the year 1875. I had my small store of Field's orange vermilion out of my reach, and I inquired very carefully at the artist's colourman—where before I used to obtain perfect examples of this colour—whether what was now sold by them was the same. They assured me that it was even improved, although made by exactly the same process. I was painting flesh in strong light, which I wished to be particularly delicate, and this orange-vermilion, with white, &c., if good, seemed the fittest for my task. Each time that I left off my work, I felt satisfied with the colour, but great was my dismay to find, on looking at it after ten days, that the whole face was dirty and smeary. At first, I thought that my eye, or a dark day, had deceived me, and I scraped out my work and did it again, with the same degree of satisfaction and of disenchantment in turn. When I suspected the pigments, it was necessary to determine which was at fault, and whether it would not be better to use zinc white instead of flake white. These experiments were made at this juncture for the special object I have named. In two weeks, the orange vermilion and flake white had come to the tint which you now see—a sort of *café au lait* colour. I had, at the same time, mixed it with zinc white, and this was unchanged; indeed, it now fairly shows the original colour; but, for fair flesh, one also wants some pink made of crimson. I had purchased some madder carmine in powder, which was recommended, and which appeared to be of peculiar beauty; it is here mixed with the zinc white. Unfortunately, the leaden-hued veins, which deaden this combination, did not at first appear, and I determined to make my flesh colour for the last time of zinc white. The end was that I lost all my labour, for in trying to avoid Charybdis, I had been wrecked on Scylla, and I had to hide my picture away, instead of exhibiting it. I took the orange vermilion to Mr. A. G. Stewart, who, on analysing it, found between 10 and 12 per cent. of foreign matter, principally lead, in it. When I made this discovery, I bought samples of vermilion from every colourman in London. In making my search, I called at a chemical factory in Finsbury. Mr. Johnson, whom I was fortunate enough to see, did not deal in colours, but in kindness he obtained for me some samples of genuine Chinese vermilion. I made up a small parcel of this, and, in haste, labelled it "Johnson's vermilion." The analyst, in due course, sent me word that every sample had been found to contain foreign matter except one, entitled "Johnson's vermilion," which defied all tests. Of the exquisite madder carmine, he expressed himself as tolerably certain that it was mainly composed of aniline dye. Look at these different samples, called madder carmine. Any practised painter, familiar with the delicate colour which we used to have thirty years since, and which, up to the last ten years, only varied in being richer, will see in this dead piece of vividity a terrible example of the insidious changes of which we are the victims. I know it is said that the aniline dye carmine is absolutely in all its elements the same thing as the madder carmine; but the change with zinc white shown here, and the character of the unmitigated carmine, as it presents itself to the eye, proves a difference of nature of a very fatal kind; and I am quite sure that the sooner the madder root is again cultivated as before, and this aniline dye is discarded for all high purposes, the better it will be for good taste. This canvas has a more pleasing office, in testifying to the great value of No. 1 cobalt green. I have now tried it for ten years, and I have ever found, as in this experiment, that it is absolutely unchangeable, either alone or mixed. It is a perfect substitute for emerald green, although not quite so vivid at first. Malachite green was not originally far from the same colour; the difference now is very marked; where mixed with cadmium, the cobalt green is as at first, the malachite is black. On the third canvas is a curious example of the sensitiveness of this colour. You will observe that it is placed in a square immediately under one of vermilion, as, when wet, it was running down the canvas; this was turned, and the colour ran over the dry vermilion, which changed it to a black; but what is more surprising is the fact that, where the two pigments do not touch by a quarter of an inch, the mere atmosphere of the bi-sulphuret of mercury has deepened the green into no colour. Many other instructive lessons these canvases of colours *à la mode* demonstrate, which no finished paintings can teach. One other only I will now call your attention to—the state of efflorescence affecting French ultramarine. On careful inspection, you will dis-

cover a bloom upon each of the ordinary specimens, but Winsor and Newton's preparation, called brilliant ultramarine, has never had any such marks of disintegration. No. 2 is a small canvas, on which I placed specimens of colour from a French maker, procured by the kindness of Mr. Alexander Young Stewart, of Apothecaries'-hall. The madders are peculiarly beautiful; the yellows are also very superior, although not in all cases unchanged. Some exquisite lumps of ultramarine won my admiration at the last Paris Exhibition. They were manufactured by Messrs. Bottelberg, of Belgium. Some samples of these are to be seen on No. 3; they are the finest made blues I have ever seen. The purple tint well deserves admiration, although as ultramarine it almost excites incredulity; but it is a very valuable colour. All of these varieties seem to be free from danger of disintegration, which commences very early. Canvas No. 4 has samples of colour which the Rev. Mr. Larkhart, once a missionary in China, was kind enough to supply me with; they are from a stock which he himself procured there as curiosities. Sir Philip Cunliffe Owen has now generously exercised his influence to procure me further samples of Chinese and Japanese colours. I was too late in Paris to see the complete collections from these two countries, which have always enjoyed a high reputation for their skill in the manufacture of beautiful tints. From the Indian department at Paris, by Mr. P. L. Simmonds' politeness, I obtained many samples of the native earths. These I have washed and ground, and they are shown, together with others bought in Bombay by my friend, Dr. Sim. One of these latter has the name "Kurmous," evidently a form of kermes, given, as we give "crimson" to reds, from other sources. This colour is an important one, and must be further investigated. Mr. Terry, the master of the School of Design at Bombay, obligingly procured for me specimens of all the earths obtainable in the Bengal Presidency. These I have had ground and placed upon the large canvas No. 5. It is, I think, desirable that further research should be made, that all colours used in India should be registered: in many cases, it may—as, perhaps, now—be that they are only valuable as curiosities, but occasionally a very unique and useful colour may be discovered. Our art, I think, deserves such expenditure of care. I here call your attention to one of the crude colours which I have obtained from afar. It is the original Naples yellow. This came from one of the Lipari Islands, owned by a Glasgow firm. As Cennino Cennini explains, it was a product of volcanoes. The incomplete means of transit of past days—perhaps, also, the irregularity of the supply from Vesuvius—encouraged the fabrication of this by chemical means. Speaking roughly from Merimée, the factitious colour may, perhaps, be called a combination of antimony and lead. Both the natural and the artificial were in danger of blackening by contact with iron. Notwithstanding this inconvenience, the colour was much prized, because it had the recommendation of centuries; but, about the year 1830, gradually a new manufacture, called French Naples yellow, came in, and, as the Norwegian rats drove out the old ones, so did this new pigment, because it made the claim of not being subject to change by contact with iron. Having trustingly accepted this new claimant to the honoured name on which C. Cennini lavishes his praise, congratulating ourselves on a perfect form of this tint—which is quite indispensable for flesh-painting—we made the discovery, a few years since, that this perfected chemical product had, in turn, been quietly discarded, and, in its place, a mechanical combination of flake white and cadmium, or flake white and chrome yellow, had been supplied to us when we applied for Naples yellow.

Let us now examine the state of our oil. I will tell the history of my progressive enlightenment on this important point. An article which appeared about ten years ago in a review explained that, before the Crimean War, our stock of seed for making oil came principally from the ports of the Black Sea. There was then a practice in the trade of a kind somewhat surprising to a stranger. It was to empty into the hold of the vessel one measure of hemp or other common seed to thirty-nine of linseed. This was called legitimate adulteration. The war destroyed this trade, and linseed was subsequently brought from India, where the quality was inferior, and where carelessness in planting and reaping the crops caused the seed to be less unmixed; but, in addition to this inferiority, the trade had thought well to advance its legitimate adulteration to the extent of one measure to every nineteen. After reading this, Dr. Sim told me that he had been unable to find perfect linseed oil in all England, and that he had to procure what he wanted by having the seed carefully sorted out one by one by the fingers. And since then I have had the declaration as to the impossibility of getting pure linseed oil through ordinary channels confirmed by the best chemists. The lemon yellow on No. 1 canvas speaks of the character of poppy or nut oil. This has been destructive to the colour. Probably it was from unripened, or, if the seed itself was unquestionable in excellence, the oil expressed may have been used too new, in which state there is an acid in it that may injure, directly or indirectly, by keeping it wet, until it becomes rancid. The care with which the old masters treated their colours did not exceed that which they gave to their oils, which may look bright without being perfect.

We have now, lastly, to continue what, perhaps, for some reasons, should have been considered earlier; for, without due attention to this important matter, science of the most consummate kind is thrown away in the secondary stages. It is the consideration of the qualities to be sought in canvases and panels. First, I will invite you to look at the canvases in this little book. It is composed of specimens from the Continent, and they are not recommended as cheap; on the contrary, they are rather costly. Amongst these you will find cloth of cotton fibre, which is highly objectionable, because of its susceptibility to the changing influences of the atmosphere, ever expanding and contracting, and so disturbing the preparation. Others are of hemp fibre. The Bolognese seem to have painted on hemp cloth, and I am assured by one friend that, properly selected and woven, no fibre could be better suited for the painter's purpose. The other samples are of linen cloth; but they, like the others, are of such poor solidity, that they have the very least of the merit of their kind, and the last do not save the whole set

from condemnation as unfit for any but the work of the youngest student. In the Paris Exhibition I saw but few samples of foreign prepared canvas; those which were shown were remarkably flimsy and poor. I have, however, seen French canvases sold here of great thickness and regularity of texture. These were, however, all of hemp, and I must admit a lasting prejudice against the fibre, because, in all pieces that I have examined, the folding of the cloth breaks the texture, just as the doubling of paper cracks that material. Some canvas prepared in Italy with tempera ground, is worth attention, not from the character of the cloth, which is too thin for large works, but from the tenacity of the priming, which no rubbing will cause to come away in powder or flakes. The seller refused to explain his process. Doubtless, it is a traditional one. The canvases on which I have made experiments with colours are all, I am inclined to think, too thin, unless for very small works, but No. 6 is the stoutest to be to be found in London. I have been searching at linen merchants for a stronger but regular fabric. No. 7 is a sample of sail-cloth, made of the best preserved linen fibre, of the longest and finest character, chosen in order to make canvas of the greatest strength and lightness combined, suitable for life-boats. The canvas of old masters, and of Turner's "Calais Pier" and "The Shipwreck" are of at least this substance. I have usually laid this with gesso; but there is a piece, obligingly prepared by Messrs. Winsor and Newton in oil, which I have found very satisfactory for work on a large scale. It is to be seen whether it could be prepared suitably for small work. One canvas here may serve as a caution against laying a ground on a canvas not duly pulled out, and with the layers too quickly superimposed one on the other, which makes the ground brittle. In pumice-stoning the shifting canvas, the preparation has opened on the doubling surface. A few panels I have brought to add to the collection of experiments which, in their result, form lessons against too great confidence in first experiments made after the directions of old authorities, who wrote either with the intention of preserving their secrets from the uninitiated, as some suspect, or else with the assumption that none, without great practical experience to fill up the *lacunæ* in the description, would care to put the directions to a practical test. China clay is the material of the ground in No. 8. It is prescribed in Volpato, and should be a very excellent base for painting on. From some want of knowledge on my part, you will observe that it has splintered itself in fragments. Pipe-clay grounds, recommended by Pacheco are sampled in No. 9. They disappoint me, from the dingy colour. Haydon somewhere had gathered that the "Bacchus and Ariadne" was on such a ground, and so the experiment has special interest, and deserves further attention. No. 10 shows a ground prepared simply with flake white, mixed with nut oil. My man was too hasty in repeating the coats, and the result is very instructive as to the reason why the sky in Turner's "Hoar Frost" has the incurable malady of gaping wounds. I offer these as specimens of instructive experiments, suitable for exhibition in a museum of preparations for our art. We have now to come to the conclusion of the whole matter. What I have given is the barest sketch of the evidence on our present condition, as this has chanced to lay itself before me and my immediate friends.

In the last fifteen years it may be said that a general conviction has been growing in the minds of painters, that an effort should be made to master the nature of the materials with which the art is conducted. Mr. Barff—who first, I believe, in this room proved his fitness for the post—was appointed by the Royal Academy to deliver lectures on the chemistry of colours. His efforts have, I doubt not, effected much in teaching his hearers the nature of the pigments they use. Together with this manifestation of interest in the material question, artists have made experiments in painting on tempera grounds, and some have strained raw canvas, and laid their own preparations to work upon, which before, I believe, none but two distinguished—but, withal, as they were thought, eccentric—artists had done. Mr. Liebreich's lectures at the Royal Institution, and certain articles in the "Portfolio," contributed by various artists, detailing manners of work, and revelations made in the "Athenæum," are other proofs of the conviction gaining ground that we have still much to learn before we can be in a position of safety. I do not regard anything that is being done as enough going to the root of the difficulty. All is done too much with the determination to keep our clean-handed amateur superiority. But I take these facts as encouragement to think that an appeal to the profession to organise some system by which henceforth the student shall be provided with a knowledge of the servile questions of the craft, may find many others determined to make their life-bought observations a nucleus of knowledge for the benefit of the next generation.

The evidence given amounts, I think, to this, that in this day—150 years after the commencement of English art—we have no more mastery of our craft, as such, than that with which Hogarth, Gainsborough, and Reynolds commenced their careers. Reynolds's very mistakes testify to his anxiety to establish some certain knowledge of the matter as much as to the blankness of the guidance he had received. The jealousy with which he guarded his secrets from even his pupils was instigated probably by a desire to avow no habits not warranted by success. His enemies had assailed him as one using materials that were perishable. When his weary eyes urged him, finally, to put down his life-kindling brush, the experience that he had gained resulted in no gain to his successors. Hilton, Wilkie, Etty, Turner, and, lastly, Maclise, began their application to the art of painting with no help from their predecessors. The last has left laborious works which, even within 40 or 30 years, or less, are so ruined, from his ignorance of the art of painting, that the uninformed observer would be led to conclude that they had been done by a process—not which had before been tried for 400 years, but which had never before been put to the test. Beside those adduced, which suffered from misdirection by the colourman, "Captain Roche" and "The Marriage of Strongbow"—which I saw only lately—are my justification for thus speaking. What this painter had, in the end, learnt as to what was safe and what unsafe in practice, no one now knows. The lessons

of his life's practice all died with him, as had the essence of the experience of previous painters; as will, again, our own dearly-bought knowledge, unless some change be made of radical importance in our system. Will it not be the best proof of our devotion to our art—of our faith in our national genius, and even of the high purpose of the art of the civilised world—if we put ourselves to the task of determining upon some course that shall liberate us from our increasing helplessness. The fear of making a scandal, of hurting the feelings, of exciting the hostility of the many having a vested interest in the present state of the business connected with art, have not been without influence in preventing the evil being laid bare. It is my duty here to insist upon it that there is a sore, and to track the evidence of this, passing by all that betokens independent health; and this determination may easily be construed as signs of prejudice or exaggeration on my part. I do regret this possibility, for I declare again that I have respect for the character of the gentlemen who conduct the businesses which supply us with our materials, and that the intelligence and principle which guide them have saved us from disaster of more serious kind than that I have noted, and have secured good results of great importance, which I have had to pass by. I must not, however, fear to declare that it is high time that the wound should be probed, and that a remedy should be found. In England, we pride ourselves upon being the first to bring out our defects to the light of day. It is, with reason, thought to be a means of ensuring continued vitality. Should we, in art, be the only Englishmen acting on a different rule? The cure that we have to seek is one it is possible to define compactly. It is to establish a means of transmitting the practical wisdom of one generation of painters to another.

The true way to accomplish this object, it seems to certain painters, has been to found a society for looking after the material interests of painting—which, at present, is very small, but which may be extended as circumstances suggest; that this society should be mainly composed of important members of the profession of painting, not chosen with any pretension to define their *status* in genius; that this body shall elect an acting council, to be replaced by rotation; that a library should be formed of all works of literature which exist on the subject of artistic practices; that we should establish a workshop for the preparation of materials; that we should arrange for the importing of colours from abroad, for collecting specimens of experiments, many of which may now be spread about in the hands of individual artists, who would be glad to secure a future use for them at their death; that we should make a complete collection of experiments with colours, varnishes, and oils, simple and mixed, making careful explanations that, in future years, no one may be deluded, as we are now, by complexities arising from misnomers—from such, for example, as the name of Naples yellow being given to a succession of pigments having no points in common; or by that of "terre vert" to a compound, the principal colouring matter of which is simple "verdegris;" or that of pink madder to a preparation intensified with cochineal carmine, or still worse, of madder carmine made with pestilential aniline dye; or of vermilion, which is greatly composed of lead; or the name of oil colours to mixtures in tubes in which there is unavowed wax. All due steps shall be taken that men in future generations may not, from finding false names given to our materials, be led to erroneous conclusions of the character of the true articles. I would suggest that this society should seek to obtain as members gentlemen of reputation in chemical science, who may advise us on matters in which artistic experience alone would reveal only our wants, and not direct to the means of satisfying these.

An important object of the society will be to cultivate our opportunities of obtaining further samples of every variety of colours existing in the far East, of proving these, and putting them on record in our museum for all generations to see. We should take the needful steps to secure an ample stock of oils and varnishes of refined character, of obtaining and experimenting with what may be the base of the great secret which originated the modern art of painting, *i.e.*, the distilled oils which Leonardo da Vinci would not do without, and which now no painter uses. We should also obtain a supply of good papers for water colours, which is now scarcely to be had. While obtaining the collection of precious materials, we need not delay to establish a workshop, in which every operation could be conducted under our own eyes, and, as it settled into working order, this must be utilised as a school for the graduation of students in the different duties of mechanical science valuable to a painter. This may secure to us all the mechanical lore of Cennino's system of tutelage. I believe that three months in part of evening work would give a man a basis of good knowledge of his subject; that he would then be in a position to understand the reason of unexpected experience in his practice of painting, such as now is regarded as beyond the explanation of any but the colourman; and every day he would be more capable of imparting knowledge to others. To aid all in this desirable attainment, it would be important to keep an exact register of every preparation made in the workship, to be open for consultation at all times, that the cause of remarkable results might be easily traced. Much more might be said of the ultimate aims of the society; but the object here is only to enable the audience to judge of the necessity of some new controlling influence on the character of our materials, and to show that such an institution would best effect the purpose. I would, moreover, explain that in no respect would it be a competitor to any existing institution. It would, indeed, trench on the province of artists' colourmen; but it would only put those businesses, which are conducted on the principle of meeting the requirements of the time, and which would court investigation, upon a safer footing, because it would secure for them greater appreciation of their merits. It would, doubtless, damage those conducted on any system of secresy and make-belief, and this should not be discouraged as part of our hopes. I believe that the workshop might be made an example of clean and careful production, and that, as a technical school, it would give knowledge that would serve as a key to many mysteries now but darkly read in the pages of old writers, on the practices of the painters of their day; that thus we should be the inheritors,

not only of our immediate predecessors, but the heirs of all the ages, and that, though our pretensions would not be ostentatious, in our humble way, we might be proud that we should be repeating the chosen tasks of the gods — the directing of inert matter to a spiritual end.

DISCUSSION.

The Chairman said that the subject on which Mr. Hunt had read so admirable a paper was a very important one, and he would suggest that some future opportunity should be taken for its discussion, especially as the paper itself had taken up so much time as to preclude the possibility of its being properly discussed at that late hour. The subject was one which must deeply interest Englishmen, and indeed all people who were alive to the importance of art, and more particularly must it interest artists themselves. There was no doubt a crying necessity for a thorough investigation into the materials used in painting. Artists were not like members of the literary and other professions, for instance, who could publish their works, and whose ideas flowed through a thousand different channels to the public; artists depended on the canvas on which they worked, and on the colours they used, and it was important that their ideas should be made as permanent as the materials through which they were conveyed would allow. He concluded by proposing a hearty vote of thanks to Mr. Holman Hunt for his valuable and important paper.

Mr. Holman Hunt, in acknowledging the vote of thanks, said the subject was so large that it was really quite impossible to discuss it at the fag-end of such a lengthy meeting, and Sir Coutts Lindsay had expressed a very good idea, in saying that artists, who were specially interested in the question, should fix upon a time for holding a meeting, at either the Grosvenor Gallery or some other place appropriate to the subject, where they might consider how the scheme referred to could be carried out for supplying artists with good materials for their work. He might say that he and the friends connected with him in the matter, desired to be very careful to avoid making it a mere dividend-paying affair. They felt that that would be one of the first dangers to be guarded against, and they wished to secure that any profits that might arise from it should rather be employed in encouraging the perfect manufacture of materials. While he did not despair of benefit arising immediately to themselves, advantage would certainly accrue from it to their successors. It would be a comfort to feel that something should come of it in the future, if not in the present.

The meeting then adjourned.

MISCELLANEOUS.

THE INVENTION OF THE REAPING MACHINE.

Since the publication of the particulars respecting the inventor of the reaping machine in the *Journal* (vol. xxvi., pp. 369, 419, 479), Mr. G. K. Thompson has continued his inquiries on the subject, and now sends some further corroboration of the claims of John Common. Mr. Thompson writes as follows :—

Sir,—Two years ago, you kindly inserted in your *Journal* some particulars respecting the invention of the reaping machine, and in support of the claim of Mr. John Common to that honour. I have been since then making further inquiries on the subject, and I think the enclosed communication, which I have just received from a descendant of the Mr. Thomas Brown who made parts of the machine from Common's instructions, will strengthen that claim, and thus prove conclusively that Mr. McCormick is not the inventor; nor is the machine American, but wholly English. The dates given coincide with Common's statements in every way. (See *Journal of Society of Arts*, March 22, April 5 and 26, 1878.)

Perhaps you can find space in the *Journal* for this further light on the matter, and oblige yours faithfully,

G. H. Thompson.

The following is a copy of the letter alluded to above:—

74, Brook-street, Toronto.
March 15, 1880.

My dear Sir,—Your favour of Feb. 13th, and copy of *Alnwick Journal* are duly to hand. In reference to your inquiries regarding my grandfather, the late Thomas Brown, and his family, formerly of Alnwick, I beg to say they emigrated to Quebec, Canada, and shortly after removed to the town of Sterling, Cayuga County, State of New York, United States, where he purchased a farm, and resided there until his death, in March, 1850. With respect to the invention of the reaping machine, all I know is what my grandfather, the late Thomas Brown, and his son Peter told me, which is that McCormick, who at that time resided at Auburn, some 20 to 30 miles south from Sterling, in the same county, having heard of my grandfather, came to him and inquired about his reaping machine. He explained it to McCormick fully, and gave him a model of the machine (I never heard patterns mentioned). This was a few years (perhaps five) before I came to see my grandfather, in 1848; I, therefore, never saw a pattern or model of the machine, and, consequently, can give you no information regarding it; nor did I ever hear the name of a Mr. Common mentioned.

I have in my possession a scrap-book belonging to my late grandfather, containing a controversy, or series of letters, published in the *Newcastle Chronicle*, of Aug. 1821, between him and John French, a blacksmith, regarding the invention of turnip seed drill, and herein I enclose you a copy of part of one of the letters, being the only mention made of the reaping machine.

During my residence with my grandfather and uncle Peter, I had several conversations in regard to his inventions of the "Northumberland iron plough," "seed drills," "tobacco cutter," "turnip cutter," "tallow cutter," "fruit crusher," &c., also his reaping machine, but nothing was ever elicited about the reaper but that McCormick, of Auburn, got the model, and soon commenced manufacturing them. It is, therefore, beyond all doubt that McCormick got his first idea of the reaping machine from my late grandfather, Thomas Brown.—Very truly yours,

J. P. Nichol.

Mr. G. H. Thompson, Alnwick.

Extract from the "Newcastle Chronicle," Aug. 8th, 1821.

"With respect to my reaping machine, I can give Mr. F. the lie direct in every statement, I never received 30 guineas, and I made a machine fit for the field. The *Newcastle Chronicle* of October 19th, 1816, states that it was tried on October 3rd, 1816, in a field of wheat belonging to T. Dodds, Esq., south side, and far exceeded the expectation of everyone who saw it work, and bids fair to give satisfaction; it will cut six or seven acres a day, and much more even and low than by the sickle, &c. It was also tried before a number of gentlemen farmers at the barn-yards, and gave equal satisfaction. The labouring people reproached me with taking the bread out of their mouths, and I was induced

to desist from (making) the machine, from the extreme opposition they showed to it."

Thomas Brown.

SHIPPING IN NEW ZEALAND.

The Registrar-General for New Zealand reports, in his work on the Statistics of the Colony for the year 1878, that the total shipping inwards at the various ports was 926 vessels of 456,490 tonnage, being an increase, as compared with 1877, of 114 in the number of vessels, and 67,922 in the tonnage. Of the shipping inwards, 146 vessels of 134,690 tonnage arrived from the United Kingdom; 604 vessels of 252,421 tonnage from the Australian Colonies and Tasmania; 95 vessels of 37,659 tonnage from the islands in the Pacific (the arrivals from the Sandwich Islands included the American mail steamers which called there); 25 vessels of 13,398 tonnage from the United States of America; 12 vessels of 3,238 tonnage from China (Hong Kong); 20 vessels of 6,149 tonnage from the Mauritius; 6 vessels of 3,628 tonnage from Bengal; and 18 vessels of 5,307 tonnage from other ports and the Southern Whale Fishery.

The total shipping outwards was 886 vessels of 428,493 tonnage, being an increase as compared with 1877 of 38 in the number of ships and 27,884 in the tonnage. Of the shipping outwards, 84 vessels of 76,850 tonnage cleared for the United Kingdom, all with cargoes; 614 vessels of 267,010 tonnage for the Australian Colonies and Tasmania; 101 vessels of 38,567 tonnage for the Pacific Islands, of which 3 were in ballast (American mail steamers calling at Hawaii are included in the clearances for the Sandwich Islands); 23 vessels of 19,613 tonnage for the United States, of which 17 were in ballast; 12 vessels of 7,845 tonnage for Chili, of which 11 were in ballast; 20 vessels for Guam, of which 16 were in ballast; and 32 vessels of 13,066 tonnage, of which 9 were in ballast, for other ports and the Southern Whale Fishery.

The number of registered vessels belonging to ports in New Zealand on the 31st December, 1878, amounted to 541 of 46,965 tonnage, viz., 434 sailing vessels of 35,420 tonnage, and 107 steam vessels of 11,545 tonnage.

The amount of tonnage belonging to each port was as follows:—Auckland, 15,792; Napier, 740; Wellington, 8,260; Nelson, 1,023; Lyttelton, 5,283; Dunedin, 14,035; Invercargill, 832.

IMPORTS OF DISEASED PORK FROM AMERICA.

By P. L. Simmonds.

A very severe plague, of an extremely infectious character, has been for some years spreading and devastating the vast herds of swine in the United States, which has at last become so wide-spread, and so fatal in its contagious results, that the Government has instituted an official investigation, the result of which has been recently published in a special report by the Department of Agriculture, which occupies nearly 300 pages, containing the reports of nine or ten medical men and veterinary surgeons on this serious disease; and it is illustrated by about seventeen microscopical and enlarged coloured plates of the various diseased tissues, parasites, &c.

Though long confounded with typhoid fever, anthrax (malignant pustule), erysipelas, measles, scarlatina, &c., the present swine disease appears to be distinct from all of them, and may be defined as a specific contagious fever. It seems highly important that public attention should be drawn to it, in view of our enormous imports of American pork in various forms.

North America is the largest pork-raising country in the world, its swine numbering over 28 millions, as officially recorded; but the actual numbers are believed to be at least 33 millions, Russia standing second, numbering about 12,000,000 pigs. Pork-raising is, therefore, an important element in the agricultural wealth of the great transatlantic republic; and as they send away for foreign consumption such a large supply of pork products, it behoves the consuming countries to watch closely the character of the meat supplied, and to be certain that its consumption is in no way injurious to public health.

Our imports of foreign pork of late years have been very large, and chiefly from America. The following are the official figures of these imports:—

	1878.		1879.
Live swine	55,911	..	52,267
	cwts.		cwts.
Bacon, ...	3,466,565	..	3,996,922
Hams	797,336	..	906,121
Pork, salted, ...	369,500	..	400,591
,, fresh, ...	18,222	..	40,049
	4,651,623		5,343,683

Besides this, we have the import of 840,000 to 900,000 cwt. of lard from America. Although we have not yet the specific details of countries shipping for the last year, yet the returns for 1878 show that the bulk of our imports are from the United States, and over 17,000 live pigs came from there in 1878, which may serve to introduce among us this frightfully contagious disease, of which cases are already recorded.

The imports of pork products from the States, in 1878, were—

	cwts.
Bacon	3,169,025
Hams	790,348
Pork (salted)	322,148
Pork (fresh)	6,451
Lard	901,214

Now, judging from these imports (none of which are re-shipped), added to our home production of pork, the flesh of swine enters more largely into the British food-supply than would be generally supposed. More than 250,000 pigs are sold annually in the Paris markets, besides those killed annually for household use, and the sale of some 500 tons at the annual ham fair, in Lent. Hungary supplies a great quantity of bacon and lard to the whole of Europe, besides its "salami," or polonies as big as a man's arm, which are largely consumed throughout the Austrian empire.

It is admitted that trichinosis is very prevalent and fatal on the Continent, which can scarcely be wondered at, seeing that bacon and ham are so frequently eaten raw, and that the pork sausages and polonies are not sufficiently cooked to destroy the vitality of the parasite.

The investigations in America show that the parasite worms of swine are numerous. The whip-worm (*Tricocephalus Dispai*, or *crenatus*) has been found in large numbers in pigs that had been fed on raw offal. Many years ago, Dr. Fletcher called attention to the destructive effects of the lard worm (*Stephanurus dentatus*) on the liver and other internal organs, and even attributed the hog-cholera to its ravages. So with the *Trichina spiralis*, the hook-headed worm (*Echinorhynchus gigas*), the common measle hyatid (*Cysticercs cellulosa*) and the liver flukes (*Fasciola hepatica* and *Distomum lanceolatum*.) The lung worm prevalent in the present swine plague is the *Strongylus elongatus*, Dry.

The origin of this hog disease in America is attributed to various causes, to overcrowding and filth, to breeding in and in, to the general feeding on Indian corn alone, much of which has been kept and exposed to the elements for some years, to want of liberty, &c. But it is not necessary here to go into causes, or to give medical descriptions in detail. The disease is evidently a very ugly one, and the flesh, however prepared, cannot be wholesome or pleasant eating. The quotation of a few of the professional opinions given may, however, be beneficial.

That many of these diseased animals are shipped for human food appears to be admitted. Mr. D. E. Salmon, a veterinary surgeon, reporting to the Commissioners of Agriculture, says (page 130 of the report):—"One man remembers that he was employed by the drovers to kill the animals that were sick, and cure the meat; these animals had diseased lungs, and such a bad odour that they could scarcely be dressed."

Mr. Charles M. Keyser, of Cedar Point, Page County, Virginia, thus describes the disease:—"Upon examination of those slaughtered, I found their lungs and livers in a very bad condition. The lungs were very much darkened and decayed, and the pores, or small tubes, were filled with worms about the size of a hair; they varied from one to three inches in length, and seemed to completely choke the hog. In colour, they resembled that of the kidney worm, though they were not so large. I had no microscope, and could not make a close examination. The liver was was full of boils, and seemed to be in a perfectly torpid condition."

Mr. James Law, another of the reporters, is of opinion that, "in the many places where the hogs are turned out as street scavengers, and meet from all different localities, such liberty should be put a stop to wherever the disease appears in the district, and all hogs found at large should be rendered liable to summary seizure and destruction."

Dr. Reuben F. Dyer, thus reports (page 160):—"Aggregating a large number of cases in the same herd, you will find all the tissues diseased, but more particularly the lung tissues and the mucous membrane of the intestines."

Dr. Detmers recommends:—"1. That any transportation of dead, sick, or infected swine, or even of hogs or pigs that have been the least exposed to the contagion, or may possibly constitute the bearers of the same, must be effectually prohibited. 2. Every one who loses a hog or pig by swine plague must be compelled by law to bury the same immediately, or as soon as it is dead, at least four feet deep, or else to cremate the carcass at once, so that contagious or infectious principles may be thoroughly destroyed, and not be carried by dogs, wolves, rats, crows, &c., to other places."

Dr. D. Y. Voyles reports that the approach of the complaint in any given locality is the signal for the selling of every marketable animal to the summer packers, and yet in the year 1876, there were boiled down for their fat, in the county of Bartholomew, no less than 100,000 animals that died of disease, in that and adjacent counties. In North Carolina, the losses from the disease in the year ending April, 1878, were estimated at 260,000.

Dr. R. F. Dyer reports that, aggregating a large number of cases in the same herds, it will be found that the infectious poison invades all the tissues, to a greater or less extent, but more particularly the lung tissues, and the mucous membrane of the intestines. He forcibly remarks, "when it shall become universally known that diseased animals are being continually slaughtered and packed for shipment, when Europe shall learn that we are sending them cholera hog-meat to eat, then one of the greatest sources of revenue to this country will be seriously damaged. It is a notorious fact that the stock-yards, in Chicago, are full of diseased animals. Commission men say that they are selling that class of hogs for slaughtering and packing, and think nothing of it. I know that, in the yards of this town (Ottawa, Illinois), hogs die from this disease, and as healthy hogs are put into the yards preparatory for shipment, they will, of necessity, contract the malady. They are sent to market, and, about the time they should be slaughtered, are taken sick. I know this is not a very pleasant picture for those that like a steak of ham with eggs, but it is a true one; and when Congress can only appropriate the paltry sum of ten thousand dollars to aid in trying to stop this annual loss of twenty or thirty millions of dollars worth of property, I want every Congressman to just reflect that almost everything he eats has a little lard in it, and that every time he calls for ham he may be eating a piece of 'cholera hog.'"

This is not a pleasant subject to discuss, but it is one of paramount interest, which should be taken up in a legislative point of view, for the interest of the people at large, and to which the public analysts might direct their attention with advantage.

GENERAL NOTES.

Technical Education.—At the last meeting of the Court of Common Council, a letter was read from the Council of the City and Guilds Institute for the Advancement of Technical Education, asking the Court to decide as to the support which they might be disposed to give to the Institute. Mr. Beck proposed that, in consideration of the intimate association which had ever existed between the Corporation and the City Guilds, and the large funds which had been subscribed for the advancement of technical education by the latter, and in consideration also of the large representation of the Corporation on the governing body of the Institute, and of the fact that the Commissioners of the Exhibition of 1851 have consented to make a grant of a site for a Central Technical College, on the condition of the Institute erecting the building, it be referred to the Coal, Corn, and Finance Committee to consider what amount of money, if any, the Corporation should give to the building fund and also to the general funds of the Institute, and to report forthwith. Mr. Deputy Lowman-Taylor proposed as an amendment "the previous question," but this was rejected by a large majority, and Mr. Beck's resolution was carried.

Sir Henry Bessemer at the Turners' Company.—The freedom of the City and the Livery of the Turners' Company were presented to Sir Henry Bessemer, F.R.S., on Thursday, the 15th inst., "in recognition of the great services he has rendered to the world by the invention and production of Bessemer steel." Mr. Hutton Gregory, in moving the resolution, alluded to the paper on "The Manufacture of Malleable Iron and Steel without Fuel," read before the British Association, at Cheltenham, in 1856, in which the author first announced his discovery. In thanking for the honour done to him, the recipient said that from his boyhood, when he first used the lathe, the art of the turner had exercised a fascination over him. Sir Henry Bessemer was elected a member of the Society of Arts in 1850, has served on the Council, and received the Albert Medal in 1872.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

April 28.—"The Use of Gaseous Fuel, with Special Reference to its Application to Laboratory Furnaces." By Thomas Fletcher.

May 5.—"The last Forty Years of Agricultural Experience." By John C. Morton. James Caird, C.B., F.R.S., will preside.

May 12.—"Utilisation of Slag." By Charles Wood.

May 19.—"Trade Routes between England, Norway, and Siberia." By Lieut. G. T. Temple.

Indian Section.

Friday Evenings, at Eight o'clock:—

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency. Sir William Rose Robinson, K.C.S.I., will preside.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Terrien de La Couperie. Professor Robert K. Douglas will preside.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

April 27.—"Iceland and its Resources." By C. G. W. Lock. John Rae, M.D., LL.D., will preside.

May 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S. William Spottiswoode, LL.D., Pres. R.S., will preside.

May 20.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course, by R. W. Edis, F.S.A., on "Art Decoration and Furniture."

Lecture IV.—April 26.

The Entrance-hall, Staircase, Dining-room, and Library.—General treatment. Division of wall spaces. Examples of treatment. Decoration and furnishing.

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and One friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

Additional Lectures.

May 6th, 4 p.m.—Lecture by Dr. B. W. Richardson, F.R.S., on "Fleuss's New Diving Apparatus." Practical demonstration of the working of the apparatus will be given by Mr. Fleuss.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 26th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture IV.)

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. C. G. Saunders's paper, "Quantities and Quantity Practice."

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m. Annual Meeting.

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Rev. C. T. Wilson, "Uganda (Victoria Nyanza) and its People."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Tuesday, April 27th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Mr. C. G. W. Lock, "Iceland and its Resources."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. H. Scott, "Wind and Weather." (Lecture II.)

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Harrison Hayter, "The Amsterdam Ship Canal."

Royal Horticultural, South Kensington, S.W., 1 p.m.

Anthropological Institute, 4, St. Martin's-pl., W.C., 8 p.m.

Wednesday, April 28th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8 p.m. Mr. Thomas Fletcher, "The Use of Gaseous Fuel with Special Reference to its Application to Laboratory Furnaces."

Geological, Burlington-house, W., 8 p.m. 1. Prof. R. Owen, "Description of parts of the Skeleton of an Anomodant Reptile (*Platypodosaurus robustus*, Ow.) from the Trias of Graaff Reinet, South Africa." 2. Prof. J. Prestwich, "Note on the Occurrence of a new Species of *Iguanodon* in the Kimmeridge Clay at Cumnor Hurst, three miles west of Oxford." 3. Mr. J. W. Hulke, "*Iguanodon Prestwichii*, a new Species from the Kimmeridge Clay."

Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m. Annual Meeting.

Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Oliver Heaviside, "The Resistance of Galvanometers." 2. Mr. Charles Hockin, "The Determination of the Position of Faults in a Cable when two exist at the same time." 3. Mr. H. R. Kempe, "Testing by Received Currents."

London Institution, Finsbury-circus, E.C., 12 noon. Annual Meeting.

Thursday, April 29th...Royal, Burlington-house, W., 8½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. J. C. Griffiths, "Wood Engraving, its Past, Present, and Future."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture IV.)

Zoological, 11, Hanover-square, W., 1 p.m. Annual Meeting.

Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Friday, April 30th...Institute of Bankers (in the Theatre of the London Institution, Finsbury-circus, E.C.), 6 p.m. Mr. Ernest Seyd, "Foreign Exchanges, and the English Banking System."

Royal United Service Institution, Whitehall-yard, 3 p.m. Capt. William Gill, "The Chinese Army."

Royal Institution, Albemarle-street, W., 9 p.m.

Saturday, May 1st...Royal Institution, Albemarle-street, W., 2 p.m. Annual Meeting.


Map of
ICELAND
to illustrate Mr. C.G. Lock's Paper
on
"Iceland and its Resources"
English Miles
10 20 30 40 50
Geographical Miles
10 20 30 40 50
Edwd. Weller
BREIDIFJÖRDR
FAXA FJÖRDR
HUNAFLOI
Skagafjördr
Eyjafjördr
Axarfjördr
Thistilfjördr
Vopnafjördr
Myvatns Öræfi
Odada-hraun
VATNA JÖKULL
KLOFA
Skeidara Sandr
Myrdals Sandr
Reykjavik
Akureyri
Husavik
Skinnastadir
Grimsey I.
Vestmannaeyjar
Hekla
Eyjafjalla J.
Myrdals Jökull
Godalands Jökull
Merka Jökull
Torfa Jökull
Skaptar Jökull
Tungnafell Jökull
Arnarfells Jökull
Hofs Jökull
Eyriks Jökull
Langs Jökull
Ok
Oræfa Jökull
Snæfell
Herdubreid
Skjaldbreid
Sandfell
Svalbard
Sandanes
Langanes
Raufarhöfn
Thingvalla Lake
Thingvellir
Geysir
Gullfoss
Esja
Hengill
Krisuvik
Reykjanes
Kirkjuvogr
Njardvik
Keflavik
Borgarfjördr
Hvalfjördr
Faxafloi
Isafjardardjup
Arnarfjördr
Breidafjördr
Hunafloi
Skjalfandi
Öxarfjördr
Thistilfjördr
Vopnafjördr
Seydisfjördr
Eskifjördr
Reydarfjördr
Berufjördr
Hornafjördr
Lónsvik
Vestra Horn
Bjarnes Papós
Breidamerk
Hafrafellstadr
Breida-bólstadalon
Ingólfshöfdi
Ingólfshvoll
Budir
Stadr
Bordeyri
Prestbakki
Stadarholl
Hvitaberg
Arnes
Eyjar
Hólanes
Hólar
Hof
Grafaros
Vellir
Glæsibær
Hals
Reykjahlid
Grimstadir
Skeggjastadir
Svinadalr
Dettifoss
Laxárnyri
Peistareykir
Husavik
Asbyrgi
Skinnastadir
Svalbard
Sandanes
Langanes
Raufarhöfn
Thingmuli
Fossvellir
Eydar
Desjarmyri
Smorfjall
Hofteigr
Modrudalr
Skjöldólfsstadir
Blafjall
Myvatn
Reykjahlid
Grimstadir
Halldórstadir
Hólar
Mjódidalr
Ishóll
Kidagil
Kidagilshnukar
Herdubreid
Skjaldbreid
Kistufell
Snæfell
Kverkfjöll
Tungnafell
Tindafell
Blafell
Haukadalr
Soleyjarhofdi
Skaptá
Nupstad
Lómagnupar
Kaldbakr
Seljalandsfoss
Eyrarbakki
Stadarholl
Borg
Reykholt
Lundr
Saurbær
Akranes
Hvalfjördr
Mosfell
Lyklafell
Reykir
Olfusá
Laugardalr
Thjórsá
Hruni
Hagi
Skálholt
Stóruvellir
Ölfus
Hvera
Affall
Holt
Skógafoss
Markarfljót
Eyjafjalla J.
Myrdals Jökull
Godalands Jökull
Merka Jökull
Torfa Jökull
Hekla
Heida
Breidabólstadr
Hörgsdalr
Lómagnupar
Seljalandsfoss
Kaldbakr
Eyrarbakki
Stóruvellir
Thingvellir
Thingvalla Lake
Geysir
Gullfoss
Esja
Hengill
Krisuvik
Reykjanes
Kirkjuvogr
Njardvik
Keflavik
Borgarfjördr
Hvalfjördr
Faxafloi
Isafjardardjup
Arnarfjördr
Breidafjördr
Hunafloi
Skagafjördr
Eyjafjördr
Axarfjördr
Thistilfjördr
Vopnafjördr
Seydisfjördr
Eskifjördr
Reydarfjördr
Berufjördr
Hornafjördr
Lónsvik
Vestra Horn
Bjarnes Papós
Breidamerk
Hafrafellstadr
Breida-bólstadalon
Ingólfshöfdi
Ingólfshvoll
Budir
Stadr
Bordeyri
Prestbakki
Stadarholl
Hvitaberg
Arnes
Eyjar
Hólanes
Hólar
Hof
Grafaros
Vellir
Glæsibær
Hals
Reykjahlid
Grimstadir
Skeggjastadir
Svinadalr
Dettifoss
Laxárnyri
Peistareykir
Husavik
Asbyrgi
Skinnastadir
Svalbard
Sandanes
Langanes
Raufarhöfn
Thingmuli
Fossvellir
Eydar
Desjarmyri
Smorfjall
Hofteigr
Modrudalr
Skjöldólfsstadir
Blafjall
Myvatn
Reykjahlid
Grimstadir
Halldórstadir
Hólar
Mjódidalr
Ishóll
Kidagil
Kidagilshnukar
Herdubreid
Skjaldbreid
Kistufell
Snæfell
Kverkfjöll
Tungnafell
Tindafell
Blafell
Haukadalr
Soleyjarhofdi
Skaptá
Nupstad
Lómagnupar
Kaldbakr
Seljalandsfoss
Eyrarbakki
Stadarholl
Borg
Reykholt
Lundr
Saurbær
Akranes
Hvalfjördr
Mosfell
Lyklafell
Reykir
Olfusá
Laugardalr
Thjórsá
Hruni
Hagi
Skálholt

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FRIDAY, APRIL 30, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

The fourth Lecture of the third course of Cantor Lectures, on "Art Decoration and Furniture" was delivered by R. W. Edis, F.S.A., on Monday, the 26th inst., in which the entrance-hall, staircase, dining-room, and library were specially treated. Drawings, wall-papers, hangings, &c., were exhibited by the gentlemen mentioned previously, and by Messrs. Campbell and Smith.

FOREIGN AND COLONIAL SECTION.

Tuesday, April 27; John Rae, M.D., L.L.D., in the chair.

The Chairman, in introducing Mr. Lock, said he had himself visited Iceland about 20 years ago, for the purpose of a telegraphic survey, but had no opportunity for seeing the country, and was, therefore, very glad of the occasion of hearing it described by one who had spent a good deal of time there.

The paper read was on—

ICELAND, AND ITS RESOURCES.

By C. G. Warnford Lock.

Popular Notions of Iceland.—Popular notions regarding Iceland may be summed up in the following words:—"A little island in the Arctic regions; enshrouded in darkness during most of the year; covered with ice, except where volcanoes, especially Hekla, raise the temperature; and producing Iceland moss and reindeer." The idea of its possessing any trade or resources provoked a smile from those to whom I mentioned the title of my proposed paper; and newspapers, when noticing the programme of this Society's papers, mistook the word "Iceland" for a typographical error, and converted it into "Ireland."

General Sketch.—Before proceeding to a description of Iceland's resources, it will be well to give a brief general sketch of the island. In the first place, it is erroneously called small, for it has a considerably greater area than Ireland or Ceylon, and it is little inferior to Celebes, yet none of these islands is spoken of in the diminutive.

On the accompanying map,* are delineated the chief physical features of the country. As to its geographical position, it is necessary to observe that it does not come within the Arctic circle. An important point to be noticed, is the situation of the island with regard to the effects of the Polar ice and the Gulf Stream. Scarcely a year passes without the northern coast, from the Horn to Langanes, being shut in by the descent of masses of ice from the north. In some seasons, it merely lies at some distance off the coast, not even embracing Grímsey, but sending stray bergs landwards, to the danger of small craft; quite as often, it drives into every firth and bay within the same limits, cutting off all seaward communication, and forming a monotonous white field, far as eye can reach. It usually makes its appearance in the spring, from March till May, and I have seen Húsavík Bay filled in this manner in the second week of June. More rarely, say twice or thrice in a century, the eastern coast, as far south as Ingólfshöfði, is similarly enveloped, and on one or two occasions the island has been completely surrounded. During the sojourn of the ice, fog, frost, and snowstorm prevail, nipping off the young grass, which should sustain the live stock just turned out from winter quarters, and putting the inhabitants to dire straits, by the compulsory cessation from fishing operations. It is, in fact, one of the worst enemies with which Icelanders have to contend. From its level flatness, wind has little power to remove it; it often departs, indeed, in the teeth of a good breeze. It is evident, therefore, that marine currents are then the active force. This is not a fitting occasion to enter the lists in defence of the Gulf Stream, which we are now told is to be considered effete before reaching such high latitudes; but the existence of a strong marine current from the south-west is a fact which, from the influence it exerts upon navigation with Iceland, deserves some emphasis. The ordinary limits of the ice, as just pointed out, show that the southern and western shores are affected by it in very exceptional instances only. This, in itself, is not, perhaps, remarkable, as the ice comes from the north; but instead of packing, as one might expect, in the comparatively narrow passage between the north-west peninsula and Greenland, it forms a wall-like barrier on the eastern side, or round about Langanes. Experienced Danish mariners, frequenting these shores in the spring, do not attempt to reach northern ports from the east—though that is manifestly the shorter route from Copenhagen or Bergen; on the contrary, they circumnavigate the island, round the north-west peninsula, and creep along, 'twixt land and ice, whenever sufficient opening occurs. In the spring of 1876, there was, at Akureyri, a little schooner, which had performed this passage, without getting her paint scratched; a similar vessel, which had sailed on the same day from Copenhagen, made her appearance at Húsavík three weeks later, and bore evidence of a fierce battle with the ice off Langanes. There will hardly be anyone ready to attribute to the rivers of Iceland a power similar to that wielded by the Obi and

* Its orthography is *sui generis*, and does not emanate from me.

Yenisei over the ice of the Kara Sea; therefore, the explanation of the phenomena can be found only in marine currents. By due observance of these natural finger-posts, no vessel need encounter any danger from ice in Icelandic navigation. The worst months in this respect are April and May; but sometimes the unwelcome visitor does not leave till June; and, in extraordinary years, it prolongs its stay till August or September, causing a general famine.

Iceland is essentially a volcanic country, and consequently very mountainous. The whole of the centre of the island is occupied by a plateau, most of which has an elevation of about 1,500 ft. to 2,000 ft., culminating occasionally in volcanic peaks, nowhere exceeding about 6,000 ft., and covered, at all altitudes above 2,700 ft. to 3,000 ft., with perpetual snow and ice. It is worthy of note, that Hekla, which does not possess a single characteristic to place it above its fellows, monopolises the geographical knowledge of most students of Iceland; and, in the Middle Ages, it was enshrouded with a mythical halo, and became the Hades of Western Europe. The only reason to be conjectured for this prominence of Hekla, before its more remarkable and destructive neighbours, is that its name was the least unpronounceable.

The configuration of the island is the direct cause of several peculiarities of climate, hydrography, and habitation. The whole central plateau is a wild waste of lava and volcanic sand—often hidden under perpetual snow; crossed by a few bridle-paths, rarely trodden by the natives, and still more rarely by strangers; and, with one solitary exception, devoid of dwellings. The only habitable portions of the island are a narrow fringe of coast-land, and a few of the larger river valleys. The rivers, which drain the uplands, are subject to severe floods; they are disproportionately large for the island, and have so steep a gradient that a constant succession of falls and rapids renders them quite unnavigable, and exceedingly dangerous to cross. They represent, at the same time, a vast amount of motive power, where there is no machinery to move.

The great ridge of ice-clad hills, stretching across the island, acts as a refrigerator to the moisture-laden winds from the south-west, and consequently produces two distinct climates—the northern, generally dry; the southern, generally wet, and neither so warm in summer, nor so cold in winter, as the former. This fact should be noted by intending tourists.

Perhaps the greatest obstacle to the development of the resources of Iceland, is the lack of roads and wheeled conveyances. There is—and, till aëronautics are perfected, there will be—but one means of transport—the native ponies and pack-saddles. It is, therefore, often more economical to send goods by sea around the island, than by land across it, a circumstance too often disregarded by foreigners.

If Iceland has been differently described by different travellers, the Icelanders have been painted in still more opposite colours. This discrepancy may be, in great measure, ascribed to prejudices imbibed from the tourists' surroundings.

Icelandic history, from its very dawn, is inseparably entwined in our own. Colonists from British shores formed no insignificant part of the hardy settlers, who, more than a thousand years ago, occupied this lone island in the Atlantic. Anyone who will compare the English and Icelandic tongues, must be struck by the number of words which are almost identical. On one occasion, Iceland was indeed in British possession, for a brief interval, having been illegally captured by an armed merchantman.

Resources.

Such ties as history, race, or language can bind, are accounted of secondary importance in these mercenary days. The main question is what can be made out of the place. Relatively small though that may be, it is strange to see at our back door an island whose commerce was once entirely in British hands, now abandoned to the mercies of Danes, Germans, and French. So long ago as the 13th century, commercial intercourse between the chief ports of England and Iceland was firmly established, and men who engaged in the trade were rewarded with Royal subsidies and other favours. According to native accounts, the British trade was matchless; it was the most complete and the most advantageous, and gladly would it be welcomed back. What, then, does Iceland offer to the trader?

Ponies.—Among her animal products, the first place may be accorded to ponies. These are ugly, but sturdy little animals, willing, extremely docile, and accustomed to live on anything, from fish-bones to sea-weed. The Black Country imports them largely for underground work, to which their small size well adapts them. Twelve years ago, pony traffic with Iceland was almost unknown, and the increasing numbers of these animals became a burden to the inhabitants, hippophagy being prohibited by lingering superstition; but during the last ten years, the trade has been irregularly prosecuted by an ironmonger, from Leith, with considerable benefit to the island, and still greater profit to himself. The usual plan is to arrange markets at convenient centres, by means of verbal advertisement. The farmers bring their animals for the inspection of the agent, who buys such as suit him, and has them driven to a port. At least 2,000 to 3,000 ponies, of two years and upwards, might be annually exported, without robbing the island of its only conveyance. The average price of sumpter animals is about £4 a head, old ones may be picked up for £3 or less, prime ones will not be got under £5. Choice and well-tried riding-ponies fetch fancy prices, and appear in the market only in times of distress. They would not be appreciated on our level roads, but are indispensable to travel in their native land, and, over downright broken country, would show the best of our thoroughbreds a clean pair of heels. A point which has hitherto been disregarded is the variety of pace, or gait, of the Icelandic ponies. While some are trotters, others are amblers; the latter are considered more valuable, and much superior for riding, and many ponies which do not naturally amble are taught to do so by careful training. Of a herd of ponies, a certain number are sure to be amblers, and these would undoubtedly bring good prices in England, especially for children's use, as vice is unknown to them, and they glide along with a delightfully easy swing. It is alleged against them that they become fat and

lazy in this country; but the cure for that is to be found in plenty of work, rough food, and no stable. In the rigours of an Icelandic winter, a pet pony often shares his owner's bedroom; but, in our mild climate, it is positive cruelty to put the animal into a close box, and stuff him with corn. The ponies imported to this country are brought mostly by steamer, in lots of 200 to 500, during the months from June to September, inclusive. They are usually sold by auction, immediately on arrival, though common sense would indicate the benefit to be gained from a week's quiet grazing, to remove the effects of the voyage. A passage in a pony-vessel is a thing to be remembered.

Sheep.—The next animal staple is sheep. The Icelandic sheep are small, but fat; and the mutton is reputed to be the finest brought into the Edinburgh market. It much resembles Welsh mutton, and acquires its delicate flavour from the herbs on which the animals browse in the mountain pastures. A friend, dating from Edinburgh, 26th Feb., 1876, says:—"The sheep that came to Granton from Berufjörðr, as return cargo for the steamer that took out the grain for the Lord Mayor's Committee"—to relieve the famine that existed only in fertile imaginations—"proved the finest fat mutton ever seen here, superior even to our four-year-old, black-faced 'venison,' without its dryness." Sheep are bought at markets, in the same way as ponies. These markets are held in the last two weeks of September and first two weeks of October, when the animals have completed their fattening in the hills. No artificial feeding is resorted to; hence, in a great measure, the superiority of the meat. I am unable to quote the present price of sheep. In 1872, when Edinburgh went mad on this trade, the price of the best sheep averaged about £1 a head, in the Jökuldalr, which affords some of the finest. One merchant paid 27s. each for twenty exceptionally fine sheep; about 20s. for good wethers; and 15s. 9d. to 18s. for ewes which had missed lamb. These, however, were exceptional prices; the market average may be more nearly stated at 13s. 6d. to 15s. 9d. Probably, Iceland could easily spare 20,000 to 30,000 fat sheep annually. At present, besides the few live sheep supplied to our markets, a very much larger quantity of meat is killed and packed for export to Denmark. On account of the severe salting which it undergoes in the barrels, it is fit only for ships' crews, and fetches but a poor price at its destination. If sent alive to this country, much better figures might be realised. The native consumption of mutton is very small; meat is regarded as a luxury, not a necessary.

The sheep is the most valuable property the Icelander possesses, and sheep-farming is the most lucrative branch of his agriculture. It provides him with the ever-necessary milk, and with butter; the latter is generally of mediocre quality, but occasionally superior, and sometimes exported in small quantities to Denmark. A far more important article afforded by this animal is wool.

Wool.—The average weight of the fleece of a one-year old is about 1¼ lb.; of a two-year old, 2½ lb.; of a three-year old, 3 lb. Shearing is unknown; the wool is pulled off by hand when sufficiently loose. The staple is coarse, but long, and is of two distinct qualities—an outer coat, of long harsh hairs, called *tog* by the natives, and "kemp" by English wool merchants, which detracts much from the value of the sample; and an inner layer called *þel* (a word related to our "felt"), which is beautifully soft and fine. There is room for great improvement in the preparation of the wool for export, and this may help to account for the fact that the home-made woollen goods are much superior to the wool that is shipped. The export occasionally approaches two million pounds, much of which ultimately finds its way to England.

Skins.—On the table is shown a rather superior Icelandic lamb skin, which is not without a history of its own, for it belonged to the carcase which filled the saddle-bags of Dr. Clement Le Neve Foster and my father, on their ride across the great central desert of Iceland. It was dressed on arrival in England a month later. About one-half the hides of the sheep killed for shipment are exported. Ten years ago, they amounted to about 15,000 salted and 16,000 unsalted. Their principal native applications are for making shoes—a kind of mocassins—for fishing-stockings and waterproof garments, and for bags.

Catgut.—A branch of industry now much neglected in Iceland, but which might be turned to good account, is the preparation of so-called "catgut." We annually import several thousand pounds' worth of this material, chiefly from Italy and Germany. That from the former country enjoys an unequalled reputation for the manufacture of violin strings, its good qualities being ascribed entirely to the leanness of the sheep from which it is obtained. I think there would be no difficulty in finding plenty of Icelandic sheep which could fulfil that condition.

Bear and Reindeer.—Strange as it may seem, neither bears nor reindeer afford any article of export. The former animal is, indeed, an extremely rare and unwilling visitor, appearing only as the compulsory occupant of a wandering ice-floe. As to reindeer, the few that remain of once considerable herds are ruthlessly and senselessly slaughtered, whenever hard times drive them near the haunts of man. No attempt has ever been made to domesticate them. They are, as you know, not indigenous to the island, and probably will never flourish, as they have no opportunity for indulging in their favourite habit of migrating twice a year. A perfect skin and antlers would be highly valued by naturalists; two pelts, probably much mutilated, were sent to the stores, in 1872, and were valued at about 12s. each.

Foxes.—The only furs which the island produces are those of foxes. Whole chapters of light literature have been filled with impossible descriptions of the colours, the varieties, and the fishing and fowling tricks, of the Icelandic fox. Putting aside romance, there are two, or perhaps three, differently coloured robes brought to market. First, because most common, may be mentioned the white, or arctic fox. Dr. Foster has kindly permitted me to exhibit a specimen of this handsome fur. A more rare and valuable variety is the "blue," or ruddy-brown. A few out of a number which I procured, after lying for months in a damp store, realized the following prices:—Two blue, 7s. 6d. each; one blue (darker), 20s.; six white, 5s. each. The purchaser stated ordinary quotations to be:—White, 5s. to 10s.; blue, 10s. to 30s., according to the quality, colour, &c. On

the other hand, a furrier, who dressed Dr. Foster's pelts, valued the blue at 70s., and the best white at 18s. each. The local prices are about 18s. for blue, and 4s. for white.

Eider-down.—The birds of Iceland yield a number of products conspicuous for utility rather than appearance. Foremost is the well-known beautiful down obtained from that most homely dame, the eider-duck. The birth of the eider-down industry may be traced to the British trade in the fifteenth and sixteenth centuries, since which time it has continued to thrive. The birds reach the shores of the island in May and June, frequenting, year by year, the same low islets in the firths and estuaries, and are never found in inland waters. Their favourite haunts are the holmes in the Breiðifjörðr, the Isafjörðr, the Faxafjörðr, and at the mouth of the Laxá in the Skjálfandi. The duck lines her nest with the down plucked from her own body, and lays four to six eggs. These, together with the down, are partially removed, whereupon a further two to four eggs are laid, accompanied by an extra plucking of down; again the nest is robbed, as before, and a third time it is replenished by the bird, only to be re-appropriated. After the third robbing, the drake adds a contribution of about 1½ oz. of whiter down; further molestation will drive the birds away. Three nests are reckoned to give about ½ lb. of duck down, the price of which has declined within the last year or two from 18s.—19s. to 8s.—9s. a pound. The reason of this is, doubtless, to be found in the competition experienced from the "arctic down" quilts, stuffed with common duck feathers from Holland, eked out with silk waste, and less honest substitutes. A real down coverlet weighs only 1½ lb., and cannot be quilted; the so-called "down quilts" weigh 4½ lb., without being half so warm. Eider-down is cleaned by a rude process introduced from England. It is stirred about by a stick, in a sieve made of yarn; the coarse, or "tangle" down, and the impurities pass through, while the fine or "grass" down remains above. The operation, which affords a winter occupation, reduces the weight by about one-half. The fine portion only is used in coverlets, the coarse is employed in feather beds and pillows. The down from dead birds is almost valueless. The total yearly product has been placed at 6,000 lb., representing a money value of £5,000; individual farmers realise £150 to £200 annually from this source.

Feathers.—The feathers of gulls, guillemots, puffins, and other sea-fowl, when cleansed from parasites, are exported to the amount of 20,000 lb. to 40,000 lb. annually. The bodies of these birds are a very important item in the bills of fare of the natives of Grímsey and the Vestmannaeyjar, and the feathers are one of their chief sources of income. Ptarmigan feathers are much superior in all respects, but are in a minority, as these birds are mostly exported unplucked, packed in paper, and sprinkled with salt. About six tons' weight of these delicious game were exported to Denmark in 1865. They are unmercifully shot and snared by the natives, who would reap far greater profit by leaving them as an attraction for British sportsmen.

Fisheries.—It is unquestionable that Iceland's greatest resources lie in her fisheries, and especially in her sea fisheries. These form the great mainstay of the population, and for centuries past they have attracted the attention of foreigners. At one time, we took the lead in reaping these harvests, and, in James the First's day, we had 150 fishing smacks in Icelandic waters; latterly, we have allowed other nations to displace us, and the French are now almost monopolising this daring industry, finding in it an excellent school for some thousands of sailors.

Cod.—The sea-fisheries are of three kinds:—Cod, shark, and whale. The cod, which swarm around the coasts of Iceland, do not appear to be migratory, as they are to be found in more or less close proximity at all seasons. The principal native fishery is on the south and west coasts—at least, as regards export; the inhabitants of the northern and eastern districts are so much occupied with sheep and pony rearing, as to have no time for catching more than enough—and often not enough—fish to supply their own needs. Foreigners frequent all parts, and, having much superior vessels, are able to follow the fish, which gives them a great advantage over the natives. The winter and spring fishings furnish the large fat cod, which is prepared for export; the summer fishing yields only small cod, colefish, haddock, and halibut, which are smoked, dried, or salted, for local use. The fish are taken by drift-nets, deep-sea or hand lines, and long lines. The first are used only in the southern part of the Faxafjörðr, between Hafnarfjörðr and Skagi, where the fishermen anchor in 18 to 20 fathoms. Netting ceases about mid-April, and is followed by deep-sea or hand lines, furnished with French hooks, where the old Icelandic hook, 20 inches long, and 2½ lines broad, does not survive. Ordinary line fishing is resorted to when the other plans fail, and, like the last described, is usual on all the coasts. To a strong, thick line, measuring 1 to 4 "lengths" of 60 fathoms each, are spliced, at intervals of 6 to 9 ft., hanging lines, 6 ft. long, furnished with English tinned hooks (No. 5), and baited with mussels, &c. They are sunk across the mouths of firths and streams, and are taken up twice or thrice daily. On the treatment of the fish depends, in a great measure, its market value for export. The belly of the live fish is first ripped up from head to tail; the head is cut off, and the entrails are removed, the liver and roe being carefully preserved; the back-bone, down to the third joint below the navel, is next cut out; and the carcase is washed in sea-water, and placed in salt, 224 lb. of the latter sufficing for about 352 lb. of fish. After lying three or four days, the fish are taken out, well washed in sea-water, and laid out on the rocks, like laundry linen, to dry. They need frequent turning, and must be protected from dust and wet. When dry, they are stacked in piles, ready for shipment. The best brands go to Spanish ports, under the name of "Bildals clip fish," and command a high price—so much as 4d. a pound in the cargo. The inferior qualities supply Danish, English, German, and Mediterranean markets. The exports, in ordinary years, are about 2,500 tons; in good years, 3,500 tons. Besides the fish shipped by Icelanders to foreign countries, a much larger quantity is caught by foreigners; and almost as much is consumed on the spot, forming the daily food of the inhabitants. For home use, the cod is split along the back and hung up, un-

salted, to dry in "wind-houses;" it thus acquires a peculiar shrivelled appearance, and an equally peculiar toughness, which gives it the well-merited name of "hard-fish." Every traveller has remarked the primitive anvil and hammer of basalt standing before the door of all Icelandic houses, which serves to partially disintegrate the fibrous mass; but, even after that ordeal, its hardness is such as to wear down, in a most perceptible manner, the teeth of those who eat it. Having lived on it for six months, I can recommend it as being highly nutritious, and fairly digestible when sufficiently masticated. An idea of the importance of Iceland's cod fisheries may be gained from the fact that 10,000 fishermen (out of a total population of about 70,000) are engaged in them at one time; besides these, they occupy an almost equal number of foreigners, the value of the French catch being over five million francs yearly. It is computed that a vessel of 60 tons, with a crew of 12, may earn a profit of £445 in a single season's cod-fishing. Until the recent introduction of coin into Iceland, fish formed the standard of value; and the national flag adopted by the rebels, Phelps and Jörgensen, was emblazoned with three split cod-fish.

Cod-liver Oil.—In addition to its flesh, the cod yields two products, which must not be overlooked—liver-oil and roe. The former is prepared by allowing the liver to lie in tubs till the bulk of the oil exudes; this is carefully skimmed off, and forms the best quality. The livers are then gently boiled, to remove the remaining portions of oil. The annual exports of this valuable commodity, which is not always innocent of admixture with equally efficacious shark-oil, are about 10,000 barrels, valued at about 50s. each. Cod-roes, salted and dried, are largely used as ground-bait, especially in the Bay of Biscay, and are shipped from Iceland to the extent of about 1,200 barrels per annum. The price is about 11s. a barrel. The large quantities of fish-refuse, easily convertible into a highly nitrogenous manure, worth as much as £12 a ton, is neither exported nor applied locally, but is left on the beach to poison the air.

Shark-oil.—The shark, indigenous to the Icelandic and Norwegian waters, averages about 15 ft. in length, though it sometimes reaches 25 ft. In April it is found near the land, in 60 to 70 fathoms of water; later in the season it goes seawards. In summer it is caught on the west coast, in 200 fathoms of water; on the north, where it seeks the edge of the ice, in fully 300 fathoms; on the east, seldom deeper than 80 fathoms. The lines used are deep-sea log-lines, ending with three fathoms of chain, weighted in the middle with from 10 to 13 lbs. of lead, and furnished with a 6-inch iron hook, notched to hold the bait; the latter, which is made to cover the hook, may be young seal blubber, or horseflesh smoked and soaked in blood. When hauled up, the shark is robbed of its liver; the carcase is retained at the ship's side, principally in order that it shall not spoil the fishing. Though the flesh, properly treated, forms a wholesome, if not savoury, meat, no trouble is taken to preserve it. The livers are placed in barrels in the hold of the ship, and, on reaching shore, are deprived of their oil by heating in iron vessels. Most visitors will remember the boiling-down establishment near Akureyri. The first boiling gives light train oil; the second, common or dark. There is abundant room for improvement and economy in the conduct of the process. The yield of oil is usually reckoned at two barrels, or 70 gallons, from every three livers. The value of the livers is 37s. to 50s. a barrel; that of the oil, 55s. to 125s. a barrel. The chief markets for the oil are Sweden and Germany, where it is largely used in the tanneries; before the introduction of gas, Copenhagen was illuminated by this oil.

Carcase, Skin, and Gall of Shark.—The carcase of the shark is worth about 7s. 6d. as food. The skin, pegged out to dry, is used as a cheap but inefficient substitute for seal or sheep skin in shoe-making. The gall is used as soap. The annual export of train oil is about 5,000 barrels. In 1806, the export of salted shark skins reached 1,568 pieces; since then, they have not figured in the returns.

Whale-oil.—The whale fishery, in former times a chief item in the local industries, is now well-nigh extinct. It is not followed as a calling by the natives, except when they find a "school" in a firth, and can drive them ashore; and no great success seems to have attended the efforts of the enterprising American who included small cannon and explosive shells among his fishing tackle. The four kinds of whale distinguished by the natives are:—The Greenland whale, found on the north coast; the long-finned whale, yielding the most and best oil; the herring whale; and *Balæna rostrata*, the smallest, formerly often found far up the firths, especially on the north-west coast. The quantity of oil from each whale varies from 50 to 100 barrels; the belly, containing no blubber, is sometimes used for food.

Skin and Oil of Seal.—The hide of the common seal, not the long-haired variety, is prized by the natives as affording them the best and most durable leather. The carcase also yields a valuable oil. The animals are shot from boats, and give most remunerative sport.

Salmon.—Another valuable resource, hitherto shamefully abused, is the salmon fishery. Netting, spearing, and other barbarous methods of taking the fish have been carried to such excess in some streams as to make their name—"salmon-water"—an empty mockery. Instead of providing ladders in the many falls, and otherwise inducing the fish to ascend the streams to spawn, the one object sought is the capture of every fin that shows itself. Since 1624, salmon has figured as an export; in 1858, one river yielded 22,000 lb.; and, in 1870, more than 100 tons of salted salmon were shipped to foreign ports. The Icelanders have yet to learn that much more profit may be gained, both directly and indirectly, by letting out their streams, as in Norway, to English fly-fishers, than by contracting with fish-curers. Salmon fishing is the one great attraction the island offers to sportsmen, and has been fully discussed in my book.*

Forestry.—Agriculture in Iceland is at zero. At one time, the island was well wooded, and supplied itself largely, if not entirely, with cereals. But deforestation, especially in these latitudes, speedily results in an inferior climate and a sterile soil, and every grain of corn is now imported from

* "The Home of the Eddas." S. Low, 1879.

Denmark. The greatest and most permanent benefit that could be conferred upon the island would be the planting of hardy trees in favoured spots. In an official report, made several years since, I read that the Danish Government intended to encourage forestry in Iceland; but I have never heard of or met with any new plantations, and the project is so opposed to the ordinary spirit of the relations between the mother country and her colony that I regard the statement as a fable.

Iceland Moss.—There is just one vegetable which calls for notice, if only for the sake of dispelling popular illusions—I refer to the so-called "Iceland moss." It is puzzling to understand how so inappropriate a name came to be conferred on this useful drug. The learned authors of the "Pharmacographia" explain the term "moss" as being "generally applied, in Scandinavia and Iceland, to the cryptogams." As regards Iceland, at least, this is quite wrong. The Icelandic word, "mosi," is specially applied to a moss or peat bog; the Icelandic name of the Iceland moss may be translated "fell-grass," the term "grass" being applied primarily to any herbage as opposed to trees; then especially to herbs with healing powers; while the prefix "fell," or mountain, obviously alludes to the habitat of the plant. "Grass-gathering" is a regular occupation for the less robust members of the family, during the early summer months, and necessitates a period of purely nomadic life among the hills. One of the scenes in the modern Icelandic drama, "The Outlaws," is laid in the mist that surrounds a party of "grass-gatherers." Nevertheless, the production of the drug does not nearly suffice for local needs, and none is exported. As it grows abundantly in Greenland, Spitzbergen, Siberia, and Continental Scandinavia—notably Sweden, whence it is exported—the name is altogether misleading.

Sulphur.—Turning now to the mineral products of Iceland, the first which claims our attention is sulphur. The *námar*, or pits of living sulphur, scattered over considerable districts of the island, have been the theme of every author; wise men from the East, journalists, naturalists, tourists, traders, and missionaries, all have added their mite—superstitious, pseudo-scientific, or romantic—to the mass of mis-statements concerning this most simple phenomenon. Some surprise has been expressed that I did not enter fully into this subject in my book; the omission arose entirely from a regard for the delicate nerves of reviewers. Capt. Burton's fine work smelt so strongly of brimstone that, to the Edinburgh Reviewer, it recalled all the horrors of the popular nursery remedy, *minus* the treacle; and, despite all my efforts to please, a critic in the "Academy" groans under what he calls the "oppressive atmosphere of boozing and dirt" that "pervades the whole volume, and leaves an unpleasant taste in the mouth when it is finished." Clearly, the addition of sulphur fumes might have proved serious in his case.

It is not my intention to bore you with any explanation of the conditions attending the formation of vents of sulphur vapour, even although a clever paper like *Nature* (vol. xxi., pp. 89-132) has yet to learn the differences between earthquakes, eruptions, and *fumaroli*. Neglecting, therefore, the questions of how, why, and whence the sulphur comes, the chief points for consideration will be—(1) What are the peculiarities of its occurrence? and (2) what are the best means of getting it to market? The subject is rendered doubly interesting at this moment, from the fact that chemical manufacturers have recently discussed a combination to develop new sources of sulphur, in consequence of the ring formed by the pyrites companies. The principal localities where sulphur is found are the Hlíðarnámar, the Kraflanámar, the Fremri-námar, at Þeistareykir, and at Krísuvík, besides minor quantities at Hengill, and other spots. I have spent more or less time at all these places, but my chief experience has been with the four first-named. The mode of occurrence is in all cases the same. Vapours are emitted in abundant clouds from vents and fissures in the earth's crust; and around these openings are formed deposits of "flowers of sulphur," or sulphur in a very finely divided state.

I am aware that it is the fashion to describe the sulphur mines of Sicily and the sulphur diggings of Iceland on parallel lines. For all practical considerations, however, they are as distinct as a coal-seam and a forest. The Sicilian mines consist of deposits formed in past geological ages, now lying at great depths, and utterly devoid of reproductive power; the Icelandic beds, on the other hand, are the work of to-day, lie on the very surface of the ground, and live and grow with unabated energy, replacing the deposit as fast as it is removed. It is not surprising, therefore, that the minerals themselves show no analogy, beyond the fact that sulphur is present in both. From these two samples, which are not intended to illustrate the relative richness of the deposits, everyone can see for himself how little resemblance exists. The Sicilian is a hard mass of sulphur-impregnated rock; the Icelandic is a sulphur powder, more or less contaminated with foreign materials. The area comprised in the Icelandic sulphur districts collectively amounts to, perhaps, a dozen square miles; but it must not be supposed that the whole of this is equally productive. The photographs on the table will give an ideal impression of the sulphur grounds; the green spots indicate the live vents. In a very recent consular report, it is stated that an Edinburgh firm now has the whole of the brimstone trade of the island in its hands. This is emphatically incorrect, and a good opening still exists for anyone who will learn wisdom from experience. In searching the history of the working of these beds, it will be found that the chief causes of failure, when it has occurred, have been constitutional defects in the associations formed for the purpose, and ignorance of the requirements of the case. The sulphur itself has, in no instance, been wanting; indeed, it is being constantly renewed. It forms a layer of varying thickness, covered by an earthy crust, and underlaid by clays, containing sulphur mixed with various acids and salts. The sulphur layer is invariably very wet, in consequence of the steam condensed among it. The sulphur crystals are almost absolutely pure, but the simultaneous formation of other minerals, such as gypsum, and various accidents of broken surface, wind, wash, &c., help to create a mechanical admixture of impurities; so that the bodily removal of the whole sulphur layer would yield a product containing about two-thirds sulphur

to one-third impurities. Ingenious plans have been devised for separating these impurities. Two or three centuries ago, when the wars of Scandinavia were kept alive with gunpowder made from Icelandic sulphur, the method in vogue was to melt the crude mineral with train oil; the latter, taking up the earthy matters, was easily skimmed off the surface. The site of the refinery at Húsavík may still be pointed out, and deserves a visit; but let us hope that visitors, finding stray remnants of the mineral, will not, like the Edinburgh Reviewer, straightway enlarge upon the "sulphur mines of Húsavík."

The company which worked the northern diggings decided against refining of any kind, a notion being current that, with sufficient care, the sulphur might be gathered in a clean state, apart from mineral impurities. Practice demonstrated, however, that the operation, which appeared so easy in collecting pocket specimens, was exceedingly tedious and costly when the quantity had to be reckoned by tons, while more sulphur had to be left than was extracted. Moreover, the dampness and fineness of the material, coupled with the vicissitudes of climate and transport, rendered the gathered mass a dirty, wet powder. A cargo sent home resembled that contained in the bottle. Its pulverulent condition unfitted it for sulphuric acid manufacture, and its impurity was a bar to its use for gunpowder. It was forced upon the market when stocks were heavy and prices exceedingly low, and it barely found a buyer at a figure that covered its cost. Instructions were then sent to smelt the crude sulphur in *calcaroni*, as is done in Sicily to this day; one moment's thought would have shown the absurdity of attempting to smelt a heap of wet powder in a country where there is no fuel.

It remains to suggest some improvement upon former plans. In the first place, I would advise the removal, from each pit, of all the sulphur earth, to be treated with bisulphide of carbon, in order to dissolve out the sulphur. Before subjection to the bisulphide of carbon, the sulphur earth would require drying; but this might be economically managed by utilising the abundant natural heat of the steam emitted all around, in some such way as the well-known arrangement for concentrating the boracic acid solutions in the Maremma of Tuscany. Sulphur extracted by the bisulphide process is said to be preferred by gunpowder-makers and others, and has a much higher market value than the best Sicilian produce. The refuse earth may be returned lightly to the pits, so as to serve again as a filter and condenser for the escaping gases; but I would suggest a trial of the plan long ago pointed out by Dr. Foster, that of building, over the vapour-vents, suitably ventilated chambers, constructed of the ever-abundant basaltic blocks, in order to collect the future deposit as "flowers of sulphur," the most valuable form of the mineral.

The summer months should be devoted to shipping the produce, which may be collected and prepared at all seasons. The transport of the refined sulphur to the port, so far from being the great undertaking which some people prophesied, may actually be made a source of profit—at least, in the case of the northern diggings, which are the farthest inland. A tramway is to be condemned absolutely; it would be exceedingly expensive to build; it would cost a fortune to keep in repair; and it would be useless and unused for eight months out of the twelve. The island possesses its own transport system, to which the natives are accustomed; it can accomodate itself to the ways, even when they are such as is indicated in this sketch; it can be increased or diminished according to need; and it will cost nothing for repair. The basis of all transport in Iceland must be the Icelandic ponies. They should be bought in early summer, worked during the season, and finally shipped to this country, where they will fetch a price more than sufficent to liquidate their first cost, their keep, and their freight. Can we wonder that the Icelanders gave vent to their wit, when it was seriously proposed to take donkeys and coster-barrows to the island, to carry the sulphur to the coast? The pony trade is well established, and profitable; still greater benefit may be gained by combining sulphur and ponies.

Gold and Silver.—"In Iceland," says a scientific journal, "gold has been found in masses." If by "masses" is meant specks visible by the aid of a microscope, the statement may pass for a fact. Precious metals do certainly exist in more than one locality; for instance, a mineral found in the Fremri-námar yielded, on analysis, 9·19 dwt. of gold, and 14 oz. 14 dwt. of silver, to the ton, and elsewhere appreciable proportions of silver have been met with, in palagonite and trachyte. No attempt has been made to ascertain their extent.

Iceland Spar.—The double-refracting variety of calcareous spar is a special feature in the mineral economy of the island. It is found near the Eskifjörðr, in a bed, in partially transformed basalt. The native veins of spar are principally composed of the common white calcite, the transparent variety being found only in cavities in the former, enveloped in red clay and a coating of yellowish calcite. Pure specimens are valued for optical instruments, and for cabinets; when large, they fetch fancy prices; smaller samples are valued at about 1s. to 1s. 6d. a pound. For the bulk of the product, another application is found, for it is imported to Newcastle in cargoes, selling at 30s. a ton, and upwards. Several samples are exhibited. The lessee of the property pays a rental, of which three-fourths go to the Church, and the remaining fourth to the Crown; some years ago, the latter share was offered for sale at £2,500.

Other Minerals.—Chalcedonies and zeolites are spoken of by every traveller; tons may be collected of such as are on the table, but they possess neither value nor beauty. The lignite beds are of local importance only, as supplying much-needed fuel; we must doubt the author who would carve ornaments from it equal to jet. Abundance of basalt, for millstones, may be got on almost every shore. Pumice and other volcanic *ejecta* might be utilised in the manufacture of the finest hydraulic cements, in the same way as the kindred *pozzuolana* of Italy, and *Trass* of the Rhine.

Manufactures.—The manufacturing industry of Iceland is confined to woollen fabrics. In 1869, the island exported over 100,000 pairs of socks and stockings, and more than 55,000 pairs of gloves. Thanks to painstaking hand labour, their productions in this way are, as will be acknowledged from the samples on the table, singularly good.

The murret-coloured stockings, made of ordinary undyed wool, are superior, but not superlative; such may be bought at any farm for 1s. 6d. a pair. The black specimen, made of white wool dyed, is of much coarser workmanship, and inferior material; these stockings are sold, undyed, for sailors' wear, at 9d. to 1s. a pair. The thick padding on the feet is added to form a sole. In the rigours of an Icelandic winter, boots are out of the question; but, with two or three pairs of fine stockings, and a pair of these to pull on over the trousers, travel through snow and ice is rendered comfortable.

Gloves are almost always made fingerless, but with two thumb-stalls. The object of the second stall is to render the glove equally useful for either hand, and to distribute the wear; it is not, as an observant traveller has recorded, intended to accommodate the little finger. These gloves, known as "sea-gauntlets," are the constant companions of the islanders at all seasons, but especially when fishing, and are much prized by foreign sailors. The advantage of not separating the fingers is readily acknowledged when the cold is such as to demand the wearing of three pairs of gloves at once. Fingered gloves are never used locally, and their numerical proportion is not one to a thousand of the others.

There remains to be mentioned the well-known home-spun cloth, called "vaðmál," a corruption from "váðmál," signifying "stuff-measure," from the fact of its forming a standard of value and barter, before the introduction of coin. The word has been still further corrupted to "wadmal" in the Orkneys and Shetlands, and "wadmill" in England; while the first half of the word re-appears in the term "weeds" (*i.e.*, widows' weeds, and not to be confounded with the botanical word, which is of different origin). Common wadmal, like the sample shown, costs about 1s. 6d. to 1s. 9d. a yard. Better qualities are made, notably in the wool-growing district—the north-east—costing 2s. to 2s. 6d. for middling, and 2s. 9d. to 3s. 3d. for the finest. It is warm, durable, and, in a measure, waterproof; it is commonly dyed grey or black. A few knitted jerseys also are annually exported.

Import Trade.

The principal productions of the island having been exhausted, it will be appropriate to devote a few words to its wants in the way of foreign articles. This will be the more evident when it is remembered that the whole trading system is one of barter, and that the merchant who buys local wares may double his profits by supplying the needs of the islanders. Indeed, the sulphur diggings, even, may be worked much more cheaply and profitably in conjunction with a store. As to the soundness of the Icelandic trade, no doubt need be created by the failure which has attended enterprises in this direction instituted during the present century. It is not too much to say that to entrust matters to native agents is to court disaster; everything must be supervised by a responsible Englishman, who has some knowledge of the language and of the people. A large business, however, may be done without any local establishment. A ship may be despatched to visit the principal ports, taking out a stock of necessaries, and loading homewards with native goods. For this purpose, it is only requisite to obtain a "sea pass" from any Danish consular agent; the cost varies from 4s. 6d. to 9s. a last (150 cubic feet). There are no fiscal duties of any kind; at least, there were none in my day. I believe that a small duty on spirits has since been levied.

As a guide to anyone who may think of embarking in this trade, I have appended a short list of the principal imported wares, and the prices at which they were selling in the stores, in 1877; but I will not further tax your patience by reading this in detail. On the table there are numerous samples of imported fabrics, with their prices attached.

Principal Imported Articles.—Salt, for curing, 28s. a ton; steam-coals, 16s. a ton; knives and forks, 9d. to 13d.; plates, 4½d. and 7d.; cups and saucers, 7d. to 9d.; porcelain ditto, a few, 13d. to 18d.; white basins, 7d.; jugs, 7d. to 13d., according to size; other crockery in proportion; iron cooking-pots, 3d. a pound; frying-pans, 11d. to 13d.; coffee-pots, tin, 2s. 7d.; ditto, copper, 6s. 9d.; coffee-mills, 4s. 6d.; railway rugs, 27s.; shawls, 6s. 9d. to 22s. 6d.; scarves, 7d. to 4s. 6d.; stays, 15s. 6d., and upwards; scissors, 7d. to 11d.; knitting-needles, five sets of five each, assorted, 7d.; crochet-needles, 3½d.; needles, 3½d. a packet of two dozen; pins, ½d. a dozen; buttons, shirt, 7d. a dozen; trouser, 2d.; waistcoat, 7d.; cloth, 3d.; girls' boots, 11s. 3d. to 12s. 3d.; neckties, 9d.; sponges, 9d.; combs, 4½d.; small-tooth ditto, 7d. to 9d.; table-cloths, 3s. 6d.; coloured curtains, 1s. a yard; towelling, 10d.; white cambric, for shirts, collars, &c., 11d.; handkerchiefs, white and coloured, 7d. to 9d.; white braid, 2d. a knot; ribbons, assorted, 1 in. wide, 1½d. a yard; 2½ to 3 in. wide, up to 1s. a yard; sewing-cotton, black and white, 3½d. per 200 yards; thread, 3½d. to 4½d. a knot; silk-thread, 1s. 9d. to 3s. 6d. an ounce (coloured silk-thread for tassels would sell well); fingering-wool, 1s. an ounce; canvas, 3s. 4d. a yard.

The qualities of these goods cannot well be illustrated; they are very inferior, as may be judged by comparison with the textile fabrics imported. To attract customers, it would be necessary to charge less than the above figures by about 10 per cent.; and it should not be forgotten that, here as elsewhere, appearance is studied quite as much as worth. Many things of a bulky nature have been omitted from the foregoing list. The annual importation of grain amounts to about 12,000 qrs.; meal, of all kinds, over 3,000,000 lbs.; rice, 20,000 lbs.; coffee, over 250,000 lbs.; sugar, 300,000 lbs.; tobaccos, 100,000 lbs.; soap, 12,000 lbs; dyes, &c., 13,000 lbs.; bar and hoop iron, 60,000 lbs.; nails, 20,000 lbs.; iron wares, 30,000 lbs.; rope, 20,000 lbs, In cereals, I suspect we could not compete with Denmark, nor, perhaps, in coffee. Sugar sells at 6½d. a lb. for white, and 5½d. a lb. for moist.

Discussion.

Dr. Mann said the Chairman had informed him that the proper way of wearing the double-thumbed gloves was to turn in the pouch which was not used, and it would then not be noticed. Such gloves would be very useful to those people who were in the habit of losing one of a pair.

Mr. Seymour had listened with very great pleasure to the paper; which contained more interesting information on the subject than any he had ever listened to. Having visited Iceland several times, he must say that he had heard, on all sides, that Mr. Lock had devoted himself with great assiduity to study the economical resources of the country, and was one of the very few Englishmen who had thoroughly mastered the language. With regard to the herds of reindeer which were said to have once existed in Iceland, he would not presume to contradict Mr. Lock, but, to the best of his knowledge, they were only introduced towards the end of the last century, when they were turned out on the plains in the vicinity of Krisuvik, in the south-western portion of the island, from whence they had gradually retreated into the inaccessible portions, where there was no inducement to travellers to go. The sharks were chiefly fished on account of the liver, which was boiled down for oil; it was occasionally used for food by the inhabitants along the coast, but it was not very appetising. A few slices were cut from the body, and buried in the earth for two or three months, after which they were eaten. This was the best substitute for tartar emetic he knew of. Mr. Lock's observations on the mineral resources of the island were, to the best of his knowledge, correct, and his simile of the forest and the coal seam was a good and natural one. He did not, however, attribute very great importance to the amount of sulphur to be obtained from the live beds in Iceland at present, his impression being that any profit to be derived in that way would be found in the cold beds, which had been deposited earlier. The amount of sulphur to be got from the live beds would be very small; he doubted whether one or two days' work would not clear away the whole. Several plans had been tried for collecting the products of sublimation, but none had proved of any real value. He agreed that tramways were unsuited for the country, and that ponies would be far more economical. He had never heard of any gold being found, and had never seen the spar there, though he had seen it in museums in England. With all deference to the Chairman, he thought he was wrong about the gloves, for he had always seen both fingers out at the same time.

Mr. Ernest Spon said the paper contained a large amount of useful and interesting information, but they were rather at a disadvantage in discussing it, because so few had been in Iceland. He should like to ask what was the particular danger in crossing the river shown in the sketch, which seemed to be placidly pursuing its way through something like an alluvial country, though they all knew, with respect to Iceland, this was ridiculous. He understood, from reading, that these rivers ran, in great measure, through breaks in the lava and other hard rock. There was no doubt much might be done to develop the resources of this island, with proper management, and taking due account of the terrible climate, which would necessitate visits being made only at certain times of the year. He should like to hear more about the sulphur deposits, for it was becoming an important question in the commercial world where this substance could be obtained. At present the mineral from which sulphur was obtained had to be passed through several processes before it could be got in anything like a useable condition, and it appeared to him that the condition in which it was found in Iceland was peculiarly favourable for rapid economical treatment. He had had the opportunity of examining the various schemes which had been in vogue for utilising these deposits, and it seemed to him that Mr. Lock was quite correct in stating that they failed far more from home management than from the fact of deficiency of the mineral. Management had a great deal to do with the success of any commercial undertaking, and if you would manage a thing from home, and manage it badly, you must inevitably get bad results. It seemed absurd to bring home the sulphur in a crude condition, because you would have to pay freight and carriage for a good deal of worthless material, and, therefore, some chemical method should be adopted for treating it; but some plan certainly seemed worthy of being taken up commercially.

Mr. Grant, referring to a letter in a recent issue of the *Times*, with reference to telegraph communication by way of Iceland, asked what prospect there was of such an idea being carried out.

Mr. Diosy wished to ask a question with regard to the character of the people with whom anyone engaging in commercial transactions with Iceland, would have to deal. Mr. Lock said the employment of native agents would be impracticable, but did not give the reason for that statement. The Icelanders had been placed before the public in various lights. Some had extolled them as paragons of virtue, of independence, honesty, and morality, and as being the last bulwark of Christianity and civilisation towards the Arctic circle, and so forth, whilst other writers had painted them with much darker colours. Dr. Leitner, the head of the Government University at Lahore, visited Iceland at the time of the millenium of its constitution, and on his return read a paper before the Anthropological Society, in which he expressed a different opinion from most of the writers who had extolled the Icelanders, and seemed to share the opinion that they were quite untrustworthy in commercial matters. He said that crime was not prevalent, but that might partly be accounted for by the absence of any goods worth stealing. Certainly the mayor, or head man, at Reykjavik, told him that, in the seven years in which it had possessed a jail, there had been no inmate of that institution, which he said rather surprised him, for it was about the only place in Reykjavik which seemed to him comfortable enough to be worth staying in. Before British merchants could engage to any extent in trade with this island, they must have some security that the people there were not a sly, underhand race, but that at any rate they could lay claim to some of the virtues with which they had been credited. They had seen a great deal lately in American papers about the depopulation of the island, from the great emigration to Minnesota and Dacotah, and he should like to know if there were any recent information on the point, because it would not be worth while beginning a trade if the population were likely to be greatly reduced in the course of a few years.

The Chairman said, with regard to his suggestion about the glove, he derived his information from a lady, who told him that people turned in the finger when they wanted to look nice. He knew the men ordinarily did not do so, but he found it very awkward having the loose finger hanging about, especially when handling ropes or anything of that kind. With regard to the rivers, he understood that a writer, who had travelled in the East, made light of them; but he had seen a good deal of rather bad rivers in the Rocky Mountains and elsewhere, and he had very seldom seen anything worse, or even so bad, as the Iceland rivers. One reason was that the channels were generally full of great boulders, and the water being milky-white, you could not see the bottom. The way in which the ponies picked ther way amongst the stones and through strong rapids was something wonderful. Some of the rivers could not be forded at all, and they had to be crossed in a kind of box, about the size of a tea-chest, which ran on wheels on a rope, and altogether, it was a very shaky business. The language had been alluded as being very similar to English, and he could corroborate this. He was himself a native of the Orkneys, which might be considered a half-way house between London and Iceland, and he happened one day, in Iceland, to say, "I'm gaein' haem," when one of his auditors said that was exactly what they would say, and the words had

the same meaning. There were many other expressions, which were exactly the same as words still current in Orkney. Having pointed out on the map the track which he had surveyed for the telegraph, he said there would be no difficulty in laying a telegraph line there. The survey was undertaken just at the time when the Atlantic cable had failed; and an American gentleman came over with a scheme for laying a line by the Faroe Islands to Iceland, Greenland, and Labrador, so making the cable in four sections instead of one. There would be no difficulty in taking it across Iceland, though there would be in crossing Greenland; but it could be taken into one of the fiords there. The surveyors came home fully impressed with the idea that it could be easily accomplished; but shortly afterwards the Atlantic cable was satisfactorily laid, and that put an end to the scheme. There was now a plan on foot for taking a line from Norway to America, by way of Iceland. The Icelanders looked back with satisfaction to their intercourse with the English; and he must say that his party met with great kindness there. With regard to the fox-skins, it was a curious fact that the blue and white were both found in the same litter. The same thing occurred in America, where there were three kinds, the red, the cross, and the black, the latter being the most valuable skin known. Some single skins had sold in the London market for 40 guineas, whilst the red was only valued at about 15s. or 20s., yet both were found in the same litter, and he had seen and handled the little things himself. He found that in the eastern part of the island the clergy generally had the eider down harvest as part of their stipend, and there was a heavy fine for firing a shot near one of these nurseries. The seals were clever enough to take advantage of this, and he had seen them quite tame, allowing you to come within a hundred yards or so of them. The shark's meat was used a good deal in the east for food. He never saw anything so filthy as a smack which was employed in the shark fishery. She was covered with grease all over, and what surprised him was to find in the hold, besides the sharks' livers, great round lumps of whale blubber, which he was told were found in the sharks' stomachs. It was very curious how they could have cut out such a solid mass from the body of the whale. He saw sulphur in one place, but had not time to investigate it.

Mr. Lock, in reply, desired first of all to thank Mr. Seymour for the very excellent drawings with which he had enabled him to illustrate the lecture. He also agreed with him as to the date at which the reindeer were introduced, and that they were turned out in the neighbourhood of Krisuvik. His authority far saying they ever existed in considerable numbers, was a missionary, named Henderson. With regard to sharks' meat, it was an old saying that what was one man's meat was another man's poison, and he must say he had found it an excellent appetiser. He took a little bit of shark's liver which had been buried about six months, as one would take caviare; with just a nip of schnapps, it gave one an excellent appetite for breakfast. The burying it had undergone removed all the noxious oil, and it most closely resembled rusty bacon, but with a more delicate flavour. Mr. Seymour's experience with regard to the sulphur was somewhat at variance with his own. That gentleman succeeded in making some borings at the Krisuvik diggings, whereas at the northern part he (Mr. Lock) could not, because, unfortunately, all his boring rods got broken. Mr. Seymour seemed to think that very valuable sulphur deposits would be found in the cold state; he had never found any, but then he had never had an opportunity of digging far into the ground. With regard to carrying away all the deposit of live sulphur in a day or two, he thought it would require men somewhat of the stamp of the ancient Icelandic heroes to accomplish it; though, in a year or two, a considerable portion might, perhaps, be removed. It renewed itself very quickly, as was shown by the thickness of the sulphur which was deposited even in five or six days. It was only by a systematic plan of collecting all the gases, which were presumably sulphuretted hydrogen and sulphurous oxide, which acted on one another to produce the sulphur, that you would stand any chance of success. In the natural course of events the gases, as they evolved, were driven about by the wind, and consequently a great quantity of sulphur, which must otherwise be caught, was lost for all practical purposes. With regard to the rivers, it was just one of the dangers of the Icelandic rivers that they did look remarkably placid and mild, when in reality they were exceedingly dangerous. One of the dangers was the constant presence of shifting sands, which were even worse than the boulders. Another danger arose from their terrific declivity, on accouut of the high elevation where they took their rise, and their having such a short course to run to the sea. He had never seen the bisulphide of carbon process at work, but he had read a very distinct account of it as practised at a place called Swozowice, in the Austrian Empire. The deposit there was very large, in a kind of schist, a form which seemed to compare very well with that of Sicily. There they not only made their own sulphide of carbon from the sulphur, but also used it to extract the sulphur. Mr. Grant's question with regard to the telegraph had been answered by the Chairman; but if any attempt of the kind were made, he should advise that the cable should not be carried to the northern coast on account of the ice, but more to the south-western part. Any point between the Horn and Ingólfshöfði should be avoided on account of the ice. Some care would have to be exercised in selecting a landing-place on account of the rocky nature of the coast, and the considerable attrition of the cable by the action of the sea; otherwise, he saw no difficulty in the way. How Greenland might affect the question he could not say. There would be a certain number of labourers to be obtained in Iceland for an ordinary day's wage, but they were not mechanics, nor were they handy with tools. He should strongly recommend the party to take a sufficient supply of Australian frozen meat or something of the kind, because they might not be very well pleased with Icelandic fare, especially at the western part, which was the poorest. The richer portions were the northern, where the ponies were bred, and the eastern, where there were large flocks of sheep. The western part, putting aside the sulphur, was dependent on fishing; and during his own stay in the island he nearly suffered starvation from the failure of the fisheries in that district. On one occasion, when he got to a large farm, at the end of a long journey, he had to press on for several hours more, because there was not a scrap of hay left, nor any fish. On another occasion, after travelling thirteen hours, he came to a place where there was absolutely nothing to eat. Mr. Diosy asked why he should anticipate failure for any enterprise put into the hands of Icelanders. In the first place, because they were not a commercial people, and the experience of past attempts of that kind showed there was little prospect of success. There was a store belonging to a Scotchman in Reykjavík, which went on in a very bad way. Certain barrels of corn brandy being missing, it was accounted for by the statement that there had been an earthquake, which broke the barrels, that so the brandy ran into the sea. He had the pleasure of hearing Dr. Leitner's paper on Iceland, and a great deal of what he there said was no doubt true, but at the same time he did not think Dr. Leitner would like to hear what the Icelanders said about him. There was a very excellent jail built at Husavik, which he would have been an inmate of, but for the exercise of a considerable amount of shrewdness. The people were not sly, but they

were quite alive to the main chance, and would not allow any one to get the better of them if they could avoid it. The emigration question was one in which he took a great interest, and he wrote several letters to the local newspapers, strongly advising people not to emigrate. In the first place, Iceland had undeveloped resources which would keep in comfort a much larger population than it at present possessed. Again, the Icelander was not a man essentially fond of hard work, and he emigrated as a rule to Canada, where men did work hard, and in the struggle for occupation there he did not get the preference. He was a strongly built man, capable of an immense amount of exertion prolonged over a long period, but he could not do such a day's work as an English navvy. The men he employed worked without any grumbling for 14 hours out of 24, but they worked slowly, and did not do more than an Englishman would in eight or ten hours. The emigration was got up in great measure by agents who were not over particular in what they said, and he had reason to know that several men who had emigrated were very glad to get back again. Although there were no poor-houses, there was a system of mutual assistance which spoke well for the internal economy of the island. No one was allowed to starve. If a man could not get a living, some rich farmer was compelled to take him as a labourer, and supply him in return with food, lodging, and clothes, without wages; but in a country like Iceland there was nothing else on which to spend money if one had it. The Chairman was quite right about the gloves, so far as ladies, and any one who had any regard for appearance, were concerned, but as a rule an Icelander had no regard for appearances, and did not turn in the extra thumbstall. With regard to the similarity of languages, none of Sir Walter Scott's novels was more interesting, on that account, than the "Pirate;" for almost every local term which he employed as being used in Orkney was essentially Icelandic—pure Scandinavian. Dr. Rae had certainly enlightened him on the subject of fox-skins. He had been at a great loss to account for the difference in the colour of the skins, and he never succeeded—although he had 40 or 50 skins—in getting either a white or a blue cub. They were always of a mottled brown colour, and barred across the shoulders. The Icelanders had a number of stories about the colour of the fox, which plainly showed that they knew nothing whatever about it; in fact, they were not much given to investigations of any kind. It was a very good thing that firearms were not allowed to be used in the neighbourhood of eider ducks, else they would soon be frightened away, for there were a number of people who were in the habit of going out blazing away at everything they saw. In speaking of the tameness of the seals, he thought probably the Chairman alluded to the land seal, as it was called, which was actually private property, belonging to the individual on whose land it was found. The large seal was exceedingly wild, being about the most difficult game of all to approach. It generally came down with the ice from the northern regions. Mr. Lock concluded by describing the various sketches on the walls, one of which represented a waterfall, and he stated that the falls were identical in form throughout the island, being always in the shape of a horse-shoe, or wide V. He also exhibited an old copy of the Bible, printed and bound in Iceland, which had been entrusted to him for sale.

The Chairman, in proposing a vote of thanks to Mr. Lock, remarked that the information he had given about the foxes was obtained in Greenland, but the foxes in Iceland were exactly similar. Mr. Lock had not alluded to one peculiarity, viz., travellers in the summer time at least generally took up their quarters in the churches.

The vote of thanks was passed unanimously.

NINETEENTH ORDINARY MEETING.

Wednesday, April 28th, 1880; Lord Alfred S. Churchill, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Alcock, Sir Rutherford, K.C.B., F.R.G.S., 14, Great Queen-street, Westminster, S.W.
Ashburnham, The Earl of, Ashburnham-place, Battle Sussex.
Bartholomew, Hugh, Glenorchard, Torrance of Campsie, N.B.
Bourne, Craven, 2, Frith-street, Soho-square, W., and Craven-house, Beaconsfield-road, New Southgate, N.
Foskett, William John, 9, Fenchurch-street, E.C.
Grist, Samuel, 153, Adelaide-road, N.W.
Haxell, Edward Nelson, Lewgars, Kingsbury, Middlesex.
Haysman, James, Burgess-hill, Finchley-road, N.
Little, Christopher James, 17, Groombridge-road, South Hackney, E.
Romney, The Earl of, Gayton-hall, King's Lynn, Norfolk.
Shaftesbury, The Earl of, K.G., 24, Grosvenor-square, W.
Thomson, Sir William, LL.D., F.R.S., The University, Glasgow.

The following candidates were balloted for and duly elected members of the Society:—

Alexander, General Sir James, K.C.B., 35, Bedford-place, Russell-square, W.C.
Nottage, William G., Mawbyns, Breakspears-road, New-cross, S.E.
Strype, William George, Wicklow, Ireland.

The paper read was—

THE USE OF GASEOUS FUEL, WITH SPECIAL REFERENCE TO ITS APPLICATION TO LABORATORY FURNACES.

By Thomas Fletcher.

The first point to be considered is the special nature of the fuel. It must be understood that my remarks apply, in many points, equally to the ordinary gas, as made from coal, for lighting purposes, and also to air charged with the vapour of the lighter petroleums and other hydro-carbons. When gas is made from coal, a part only of the coal is volatilised and converted into gas. To get an idea of the actual fuel value of ordinary gas, I will take the results as obtained at the Manchester gas-works, where a mixture of 75 per cent. of cannel and 25 per cent. of coal is used. From one ton of this mixture the residue is about 13 cwt. of coke, 13 gallons of tar, and 25 gallons ammonia liquor. The gas produced measures 10,000 cubic feet, which, if reduced to the solid form again, would weigh about 350 lbs. If we calculate this at, say, 1s. 2d. per cwt., which is a liberal allowance for its fuel value, we get the working value of gas as a fuel at about 4d. per 1,000 cubic feet. The actual cost of the gas as delivered into the mains, including the labour, fuel, and materials used, is about 1s. 1d. or 1s. 2d. per 1,000 feet. When these figures are compared with the cost of gas to the consumer, the difference is startling, and the fact is brought pretty forcibly to our minds that we have an excessively costly fuel to deal with.

In actual use, and when burnt with proper attention to details, it is not even so costly a fuel as coal for work which requires heat on a comparatively small scale and at intervals; in fact, for most of the work to be done in small laboratories, and also for cooking purposes, it has proved itself to be a cheaper fuel than coal or coke, owing not only to the fact that every cubic foot of gas burnt may be made to render its full duty, but also when the necessary work is done, the expense is instantly stopped.

Gasoline, benzoline, and petroleum, which are hydro-carbons, are all practically the same as coal-gas in composition, varying only from each other in the temperature at which they begin to give off inflammable vapour. If we take them weight for weight with gas, a simple calculation shows them to be worth, as fuel, about 10½d. per gallon, coal gas being 3s. 6d. per 1,000 cubic feet, one gallon being about equal in fuel value to 250 feet of gas.

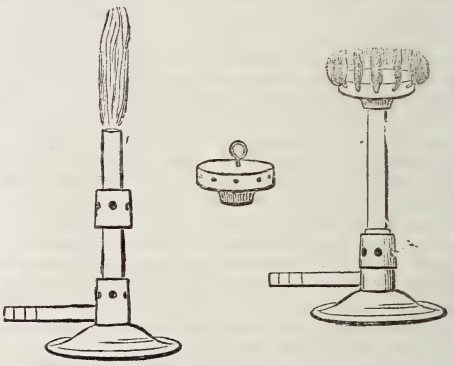
It must be clearly understood, in referring to the comparative cost of the liquid hydro-carbons, that the value, as compared with coal-gas, is only true when they are burnt as gas or vapour. When used as spray with steam, or a cold-air blast, the cost is very greatly increased, owing to the large quantity which is mechanically carried into what is practically a bath of carbonic acid gas, in or at the back of, the fire and which partially or entirely prevents its combustion. The duty obtained in spray furnaces is exceedingly low, and they are—so far as my experience enable me to judge—most costly and wasteful of fuel, unless a hot-blast is used, so as to entirely vapourise the liquid before it begins to burn

The figures I give are necessarily vague. Gas varies in quality, not only in every town, but also to a limited extent in the same town from day to day, and any exact figures for one place would not be correct for another. I simply give a rough idea of the fuel we have to do with as regards its practical value. When we consider the cost of gaseous fuel, it becomes of serious importance that the method of burning, so as to obtain a high duty, requires careful study.

So much has already been done that gas, even at its present high price, may be fairly considered a cheap fuel both for workshop and domestic use.

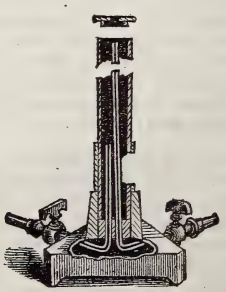
Before saying anything as to the flame to be used in furnace burners, I will explain the material used to retain the heat, and without which I believe it would be impossible to obtain many of the results which I will at the conclusion show you. It certainly would be impossible to obtain them without a very greatly increased consumption of gas. The material, of which all the furnace casings you see here to-night are made, is produced by a process patented by myself some years ago. It is a mixture of one part of refractory fire-clay or ganister, and from three to six parts of sawdust, the proportions being taken dry, by bulk. These are mixed, preferably with rice-flour paste, but water may be used for the heavier varieties, until slightly cohesive, rammed into moulds, and fired in an open kiln, with free access of air, so as to burn the sawdust out. The result is, a cellular clay, similar in texture to bread, and which retains the heat so perfectly that I can, in this casing, which is only one inch thick, melt a crucible full of cast iron, and then take the whole in my bare hands and carry it about. It will probably be better at once to explain the mode of making air gas from benzoline or petroleum spirit, as my future remarks, except, perhaps, for blow-pipe use, will include both air gas made from spirit petroleum, and also coal gas. I find, with my more recent pattern of burners for both draft and blast furnaces, that coal gas and air gas may be used interchangeably, and for many of the more delicate purposes I prefer the air gas, as being free from sulphur. The generator which I now show you contains a layer of spirit petroleum at the bottom. In this the ends of cotton screens stretched on wire are immersed, the spirit is absorbed and carried by capillary action up the cotton, exposing a large surface of spirit to the air which is blown through. To perfectly saturate the air with the vapour, this box is divided lengthways in such a manner that the air passes backwards and forwards four times the length of the box, and in traversing this distance has to pass through thirty-two cotton screens, each about five inches square. A similar arrangement is used by the Sun and Alpha air gas apparatus, these having also a mechanical blowing arrangement. They are, however, excessively costly for furnace work, having complicated and bulky parts, totally unnecessary except for lighting purposes.

Before going further, I must set right one great misconception with regard to the heat obtained from a gas flame. Many people imagine that a Bunsen, or blue smokeless flame, gives a larger



Bunsen burners.

quantity of heat than an illuminating flame. This is not the case; if the gas is equally well burnt,



Bunsen burner, with central blast for obtaining high temperatures without the use of a hot blast.

the total amount of heat from each is precisely the same, but the heat differs in one most important point in character.

The radiated heat, *i.e.*, that which travels in straight lines in all directions from the flame, and which makes the pleasant feeling of a bright fire, is far greater in quantity from an illuminating flame than from a blue one. If we want to cook a joint of meat by gas, and get the same satisfactory result as when roasted before an open fire, we use the direct radiated heat from illuminating flames placed over the meat, and inside the oven. If, without altering anything else, we convert the illuminating flame into a blue one by mixing air with the gas before burning, our cooking is practically at an end; the radiated heat disappears almost entirely, and, to get any result, we must now put the meat over the flame, and bake instead of roasting it. As you see, the hand may be held almost in contact with a non-illuminating flame, obtained by burning a mixture of gas and air. When I stop the air supply, the radiated heat becomes so intense as to be unbearable.

The actual temperature of an illuminating flame is very high, much higher than that of a blue flame; in fact, in a good illuminating flame, at the point where the white part commences, near the centre, it is sometimes possible to fuse an exceedingly fine platinum wire. It is this very high temperature which, to a great extent, causes the radiated heat observed; and, for the same reason, it is useless to expect a satisfactory gas fire made by heating blocks of asbestos with a gas flame, until a very much higher temperature flame is used than is the case at present.

When we have a crucible or solid body to heat, radiated heat is not wanted, and the most economical plan, so far as is known at present, is to use a blue smokeless flame, and to place the body to be heated in actual contact with it. By this means, the heat is rapidly taken up from the flame without the deposition of soot, and without loss of heat by radiation into the surrounding air. We must now consider the fact that all flames under ordinary conditions are hollow and cold inside. I have here a pile of gunpowder, which I will place in the centre of this large and powerful flame. You see that not only will the gunpowder remain unchanged, but the centre of the flame is actually cold. To show this more clearly, I will use a burner with a flame which can be made either solid or hollow. I will first place the gunpowder in the hollow flame and then convert it into a solid one, and thereby ignite the gunpowder.

With care, it is possible to put the hand in the centre of this flame, provided the wrist is protected by wet cloths from the outer film of flame, but it is difficult to prevent scalding by the steam which is formed by the outer film of flame and the wet cloth. The actual temperature in the centre of this flame I have tested by introducing a delicate thermometer, and find it is usually about 110° Fahrenheit. I will also prove that it is hollow, by conducting the unconsumed gas and air from the centre of the flame by a tube, and igniting it, making, as you see, a second and separate flame, this second flame disappearing when the flame is made solid.

I believe that the honour of being the first to obtain a solid flame is due to Mr. Wallace, of Manchester, whose plan I shall explain presently. He was, in fact, the pioneer of a new revelation with regard to gaseous fuel, and, I am sorry to say, his discovery has not yet obtained the attention it merits from all makers of gas apparatus for heating purposes.

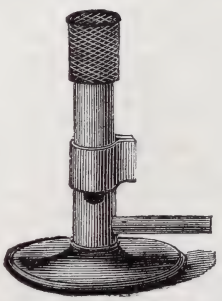
There is one condition, with regard to gaseous fuel, which requires close attention. The vessels to be heated are, as a rule, short and small; the gas must, therefore, be perfectly burnt not later than the instant the flame touches its work, and, therefore, for most purposes, a hollow and long flame is comparatively worthless.

To render the combustion more rapid, and to thereby shorten the flame, Gore, of Birmingham, first hit on the expedient of subdividing it into layers, producing a number of narrow flames with air spaces between. By this means he produced a short compound flame, which, with a little assistance from a chimney draught, would fuse cast iron in a crucible.

Following in his steps, Griffin, of London, produced a multitubular burner, virtually the same in effect as Gore's; in fact, a form of burner almost identical with Griffin's is shown on the specification of Gore's patent.

These earlier burners had all one serious fault. If the chimney draught happened to be too great for the quantity of gas available, or if the gas supply was irregular, an excess of air was pulled in and mixed with the gas, rendering the mixture explosive, and causing the burner to, what is commonly called, "light back." To prevent this, Mr. Stanistreet, of Liverpool, placed, as an experiment, a sheet of wire gauze on the top of the tubes, and communicated the result to me. With this arrangement, the gauze was destroyed every time the furnace was used, and to obviate this, I placed the gauze under the tubes, thus making the first high temperature draught furnace burner which would bear sudden changes of the gas supply without an explosion. This burner has now been superseded by another form, which I have recently invented, and which, in principle and arrangement, is totally different. To explain the principle of the new burner, I must go back a little.

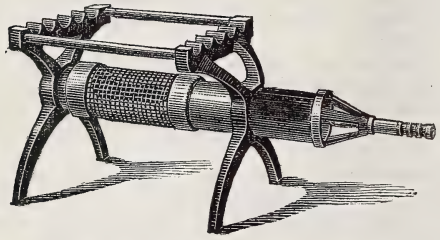
Wallace's burner is an upright tube, open at the bottom, with a small gas jet underneath, pointing directly upwards; the top of the tube is covered with a perforated copper cap. The rush of the gas from the jet carries upwards with it a large quantity of air which, with a gas jet of one exact size, produces an explosive mixture, The perforated cap prevents the flame rushing down the tube, and we



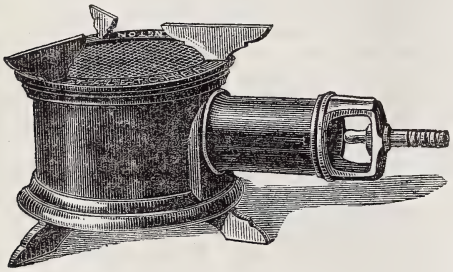
Wallace's solid-flame burner.

have, what we never had before, a solid flame, requiring no external air supply, produced by the quiet burning of an explosive mixture of gas and air. This being the case, we obtain a short flame of very high temperature, which requires no excess of air to ensure perfect combustion, and we, therefore, work so as to get the highest possible duty from our fuel.

Following in the steps of Wallace, I found great inconvenience from the height and size necessary to produce large and powerful flames, but after a long series of experiments, hit on the plan of placing Wallace's injecting jet at one end of an open horizontal tube, leaving the other end open, and enclosed in a tight box, the upper side of which is covered with gauze. With this burner I obtain, as you see, a flame solid to the centre, in a



Solid-flame burner—first experimental pattern modified from Wallace's upright solid flame.

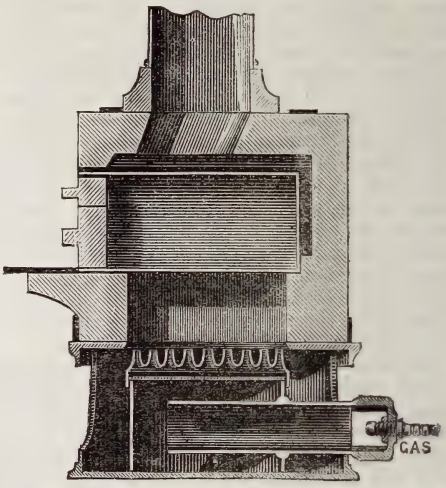


Solid-flame burner, with gauze-covered box on end of injecting tube.

convenient and simple form. I find from experience that there is no practical limit to the size of burners made on this principle. I have made them 18 inches in diameter on the surface of the gauze, capable of burning in one solid flame a gas supply of 200 cubic feet per hour; I have also made them 4 feet in length for coffee roasters. As this burner requires only an outlet for burnt air, it will work perfectly in very confined spaces, where an ordinary hollow flame burner cannot be kept lighted. A very beautiful application of this burner has been patented by Messrs. Bonser and Son, of Tower-hill, for the purpose of roasting coffee, the burner being placed inside the roasting cylinder.

I have here one of Bonser and Son's sample roasters, which will roast 1 lb. of coffee in about five minutes, and which is well worthy of examination, and also a solid flame burner, eight inches in diameter, which, with a well constructed boiler, will make steam sufficient for a one horse-power engine.

When I use this burner for draught furnaces, I make it with a cast iron grid, to prevent liability of the gauze to get red hot, and to prevent also the peculiar roaring noise caused by a solid flame produced with the assistance of a chimney, and which I shall again refer to; and you here see a few examples of its application for crucible, muffle,



Muffle furnace, with solid-flame burner, showing the cast-iron grid over the gauze.

and porcelain painter's furnaces. One great difficulty with gas crucible furnaces has been a means of safely supporting a crucible, so as to hold it securely without interfering with the full impact of the flame.

Gore, in the first gas furnace made, supported his crucible by projecting ribs inside a taper cylinder. This caused liability to stick fast, and also necessitated the use of crucibles of one exact shape and size. Griffin made an advance on this, by carrying the crucible on a tripod grate of fire-

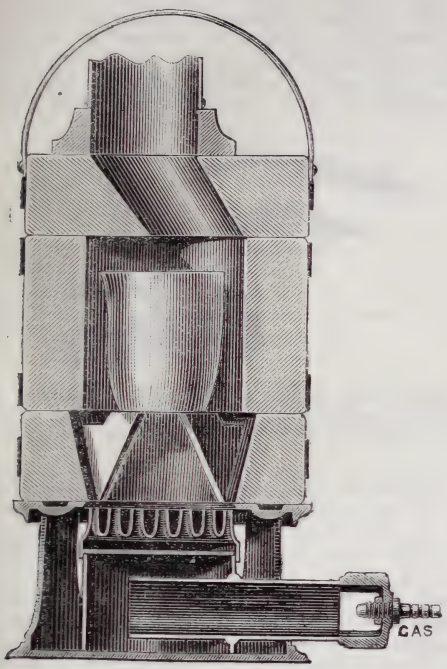


Griffin's tripod crucible support.

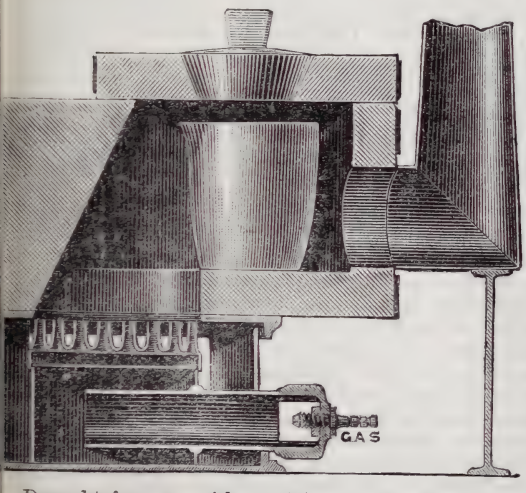
clay. This, although used at present, is liable to damage, and is not altogether satisfactory. Another plan introduced is to fix an upright plug of fire-clay in the centre of the furnace; this is, in my experience, worse than Gore's original plan, as the stand is unsteady, and is also liable to stick to and come away with the crucible.

For draught furnaces, I have at last solved this difficulty completely, by placing the crucible on the solid bottom of the furnace, by the side of the burner, and drawing the flame sideways across the crucible, the chimney being placed at the opposite side of the burner. This not only completely solves the difficulty, but places the chimney in the best possible position, and exposes the crucible more perfectly to the impact of the flame. I have

received to-day a model of a further improvement on this, in which the flame is made to traverse completely round the crucible, thus still further utilising the heat of the flame.



Draught-furnace with tripod grate, showing the old system of supporting the crucible.



Draught-furnace, with crucible standing on bottom, dispensing with tripod grate.

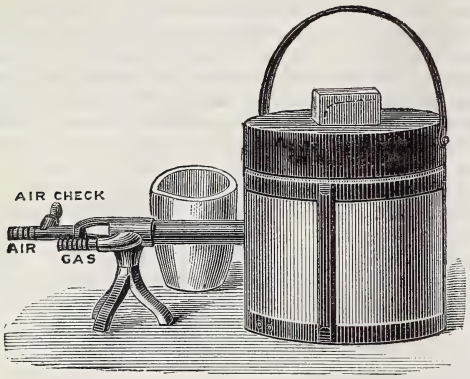
In the blast furnaces, the difficulty of supports is also overcome by placing the crucible on the bottom of the furnace, and inserting the burner at the side. The casings by which the heat is retained are of porous or cellular clay, the process of making which I have already described. All the casings which you see here to-night are made of this material, which I consider one of the most important points, where economy of fuel, speed of working, and great heat are required. Without this cellular clay, the results I obtain could not be approached, except by an enormous increase in the heating power of the burners used.

I do not think it probable, or possible, that really high temperatures will ever be attained in small draught gas furnaces, for several reasons. First, the very large burner surface necessary to make a perfect mixture of gas and air, with sufficient rapidity to burn a large quantity of gas instantly and perfectly, makes the burner liable to damage. It will be found that, with a draught gas furnace, burning in an economical manner, the flame is in absolute contact with the burner surface, a state of things which, curiously enough, does not exist with a blast furnace, where the flame is always at a greater or less distance from the face of the burner. For this reason, I should never recommend the use of draught furnaces with long chimneys for very high temperatures, although for such work as the fusion of brass, silver, and gold, the usual routine work of laboratories, and the firing of glass, china, &c., they are perfectly adapted, and if well constructed, will give a very high duty for the gas consumed.

Another objection to draught furnaces, is the difficulty of keeping all the lids and parts fitting so perfectly air-tight as to keep all cold air out of the chimney, and thereby interfering with its satisfactory working. Where the pull of the chimney is great from its height, there is a great liability to this leakage of cold air into it, and there is also a great waste of heat in keeping the chimney at a sufficiently high temperature to enable it to work efficiently. Draught furnaces have their place and fill it, but for many purposes there is nothing to approach a blast furnace, used with either coal gas or gasoline vapour. The furnace I now show you, and which I will, at the conclusion, light and keep going for ten minutes, is perhaps the most perfect example of the great results to be obtained with gaseous fuel. The casing which holds the crucible is a simple thick pot of my porous clay, with a hole in the side, and a lid with a hole in the centre for the escape of the products of combustion.

The burner, I consider, is as perfect for its work as the casing. It is a true solid flame, formed by injecting, with this little foot blower, a fine stream of air at a high pressure, into a tube, into which gas or gasoline vapour enters at the side. By using the air at a high pressure, the larger quantity of air required for combustion is pulled in mechanically at the openings in the tube, thus dispensing with the large and costly blowing apparatus, which would otherwise be necessary. The end of the tube against the hole in the casing may be open, but is then liable to make a rattling unpleasant noise; to prevent this, I cover it with a cap of gauze, which, when the furnace is at a blinding white heat, is perfectly cold, partly owing to the fact, as I previously explained, that a gas flame produced by a blast is never in absolute contact with the burner which produces it, and partly to the constant blast of cold air and gas passing through. The burner fits tight against the casing. A perfectly explosive mixture is made rapidly in very small quantities, and burnt in a close non-conduct-

ing chamber so perfectly and so instantaneously, that not a trace of flame is visible in the furnace, as may be seen by those interested, who will come and examine the furnace whilst working. In this furnace I can, as you will see, starting all cold, get a crucible well over a cast iron melting heat in five minutes, and to a blinding white, approaching a blue, heat in ten minutes.



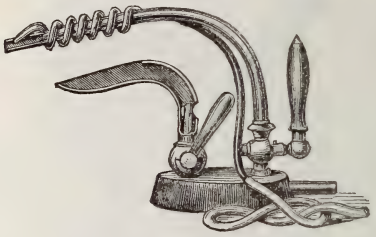
Blast furnace (injector).

The gas consumed in this furnace, as I shall work it at the conclusion, is about 40 cubic feet per hour. It therefore requires less than 4 cubic feet of gas to raise a crucible, sufficiently large to hold 2 lbs. of cast iron, to over the fusing point of cast iron, and it takes about 7 cubic feet of gas to melt this weight of iron, so that it can be poured. Let it be remembered, that this quantity of gas costs a little over one farthing, and is equivalent to about 4 ounces of coal. Let it also be remembered, that this minute quantity of fuel not only melts the iron, but heats up a cold furnace and crucible. It is very easy to work the furnace with a very small gas supply, but in this case the heat is obtained much more slowly, and the total quantity of gas used to obtain the same result is greater.

Greater power and greater rapidity of working than shown by this furnace is not desirable, although it could be easily obtained by increasing the air and gas supply. No crucibles known will stand a greater power than this furnace gives with ease, whilst for simplicity of construction, and ability to bear hard work, anything better could hardly be desired. With this furnace, I think the art of heating crucibles by gas may be considered to be complete.

Consider, for one moment, the actual results obtained in this furnace with four ounces of fuel, and compare the number of pounds of coal or coke necessary to produce the same result, then the economy of gas fuel under proper conditions, becomes self-evident. Bear in mind also that it is applicable to either coal gas or air gas from benzoline, the latter fuel enabling the furnace to be used for the fusion of pure nickel and delicate coloured enamels and glass, which the sulphur always present in coal gas would otherwise prevent the furnace being applied to. When we consider the important part which nickel is likely to play in the future for many purposes, more especially in its pure and malleable form, this power of melting this refractory metal in a simple furnace is a matter of no little importance.

I have time only to say a few words about blow-pipes. The flame of a blow-pipe is, to a certain extent, hollow; but not so much so as is the case with the ordinary flame, made without an air blast. The reason of the very high temperature obtained with a blow-pipe flame, is that the heat is driven to one point and accumulated there. I have here an example of an arrangement, devised by myself some years ago, for heating both the blast of air and the gas, producing a flame, having a temperature far above that required to melt platinum.



Blow-pipe, with air-jet coiled round the gas-pipe, and Bunsen burner underneath, to heat both gas and air before burning, so as to obtain high temperatures.

A blow-pipe flame, however large, has little power compared with the burner of the blast furnace which I have just described, when we have large bodies of material to heat. The combustion is neither so rapid nor so perfect; in fact, the blow-pipe flame is hollow and long, with only one hot point. The furnace burner flame is solid, short, and of equal temperature throughout.

I will now explain some of the differences between coal gas and gasoline or benzoline vapour, in practical use. Coal gas is never free from sulphur; and it is, therefore, difficult to use for the heating of metals and other substances, which are liable to damage by sulphur compounds. It is also not satisfactory for the fusion of enamels, except in perfectly tight chambers, from which the products of combustion can be completely excluded.

The vapours of the lighter petroleums, on the contrary, are free from sulphur, and I have repeatedly fused the most delicate enamel colours in the open flame without the slightest injury.

Another curious difference in the two fuels is, that when gasoline or benzoline vapour is used with a blow-pipe, the flame is exceedingly liable to blow out. I can use no other satisfactory simile, except that the gasoline flame appears to be "brittle," and not to hang tenaciously to the blow-pipe as a gas flame does. When anything is in the gasoline flame, which is at a sufficiently high temperature to keep up the combustion, this is no disadvantage. In the furnace, air gas from benzoline burns with perfect steadiness, precisely like coal gas, but when we attempt to use it for blow-pipe work, the flame is continually leaving the point of the jet and blowing out. In this respect the field for experiment is yet open.

I believe I obtained from my friend Mr. Bower, only last night, an idea which may serve to solve this difficulty, but which I have not been able yet to test. I found that with benzoline gas his blow-pipe was much more satisfactory than my

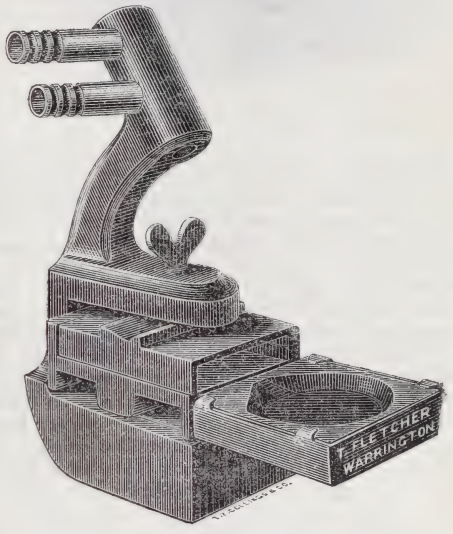
own, the only difference between the two blow-pipes being that his had an exceedingly thick air jet; mine had a very thin one. The jet of thick glass or metal does not appear to lift the flame away to the same extent, and some experiments will be made in this direction as soon as I return.

It must be remembered that coal gas is lighter than air; gasoline gas is, however, much heavier; and therefore the atmospheric, or Bunsen burners, made for coal gas, which are open at the bottom, will not work satisfactorily with gasoline gas, as the latter falls, and escapes from the lower openings. For gasoline gas, the only heating burners which can be used are those arranged in a similar manner to the solid flame burners, with a horizontal jet and air tube. On account of the weight of gasoline gas, if the generator is placed at the top of a building, the weight of the gas is sufficient to supply an argand burner in the lower part of the building, although the pressure obtained is not sufficient to work any of the common lighting burners which do not require a chimney.

I have two exeedingly curious flames to show you; one is a solid flame, produced on a surface of gauze by a chimney draught, the chimney being free to vibrate. The explosions, by the management of the chimney, can be varied in their rapidity, producing different tones. I do not recommend this in its present form as a musical instrument, I simply show it you as a curiosity. The other is a flame which requires close examination to see its beauty; and I will show it at the conclusion, whilst the furnace is working. It is produced under peculiar conditions. When the vapour of gasoline is burnt on a gauze surface, with just sufficient air to make a blue flame, the surface of the gauze is covered with innumerable round blue beads of flame, rushing about in all directions. I can offer no explanation of this, and I cannot produce the same effect with a coal gas flame under any conditions.

In conclusion, there are many purposes to which gas fuel can be applied, far more perfectly than it is at present. In fact, we may say that its use, except in blast furnaces and blow-pipes, is yet in its infancy, and the work done by Gore, Wallace, and others, may be considered only as a small sign of what is yet to come. I believe the time is, perhaps, not far distant, when gas will be used exclusively for cooking purposes, and that its rapid adoption all over the world depends only on the makers of the aparatus. If the makers of gas-heating arrangements had to pay for all the gas wasted in their apparatus, I think many improvements would very quickly be made. My own experience is that the whole of the cooking for a family of eleven can be done perfectly, entirely without the assistance of a fire, at a cost of about twopence per day for gas. When we compare this with the cost entailed by some apparatus now sold, the necessity for improvement is self-evident. Where liquids have to be boiled or vessels heated, the work must be done by one solid flame, not by a number or one hollow flame; the ovens and pans must be as shallow and broad as possible, and must also be no thicker than is absolutely necessary. I have seen gas-cooking apparatus in which some two or three cwt. of iron has to be heated before any satisfactory work can be done. My own ovens and pans are as thin as they can possibly be made, and I find, by experience, that our largest oven is fully hot in two minutes. In a properly arranged water-heater, it requires about one and a-half cubic feet of gas to boil one gallon of water; this is the result I get in actual work, under the best conditions. I may safely take it as an average, with the burners generally used for cooking, that from five to twelve cubic feet of gas is burnt to do the same work, owing partly to the improper construction of the burners, and partly to the faults, shape, and unnecessary weight of the vessels used.

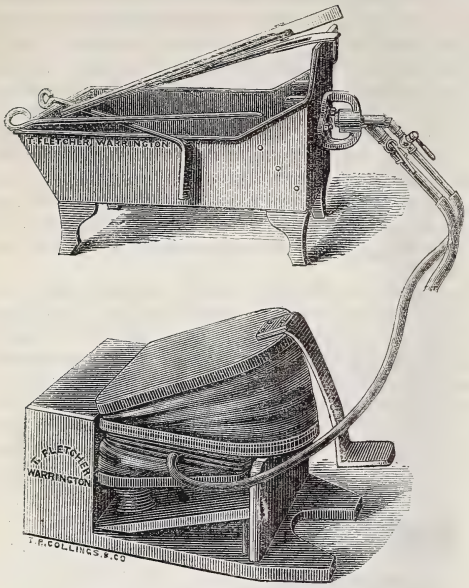
Amongst the still more recent improvements in gas-heating apparatus which have not yet been made public, I may mention two. The first, which I now show you, is a simple and cheap arrangement for melting and pouring into ingots of different shapes, a few ounces of gold or silver, without the use of a furnace. My first arrangement of this kind was essentially different: in this, as you see,



Fletcher's Furnace.

both blow-pipe, crucible, and ingot mould, are mounted on one rocking stand, the two sides of the ingot mould slide over each other to enable ingots of different shapes and weights to be cast, and the rocking stand, clamp, and blow-pipe, are all obtained in a single casting, reducing the cost of the whole to a few shillings. It is well known that the toughness and working properties of gold are greatly improved by this method of melting with a flat crucible and a blow-pipe, and the results compare very favourably with those obtained in the best furnaces. As regards time, a 3 oz. ingot can be melted and poured in two minutes with ease.

Another and more generally important apparatus is what may fairly be considered a new discovery, so far as gas is concerned. It is only too well known that good steel is ruined if heated with a gas blow-pipe flame, and that steel band saws brazed with a gas blow-pipe are brittle and worthless. It is also impossible to weld with the heat obtained from a blow-pipe. I find, by using



Fletcher's Forge and Blower.

the small hearth which I have here, filled with coke, broken small, and by directing a blow-pipe through the open tuyere, I can get a welding heat in about two or three minutes, and I obtain heat which is for all practical purposes as good as a charcoal forge. For the repair of small tools, and for such delicate forgings as are necessary for sewing machines, &c., this new adaptation of gas appears likely to become exceedingly valuable. It is, in fact, a small self-lighting forge, perfectly clean and simple in use, and adapted for the most delicate work; its value those only who have delicate steel forgings to make can appreciate.

DISCUSSION.

Mr. Hearson said he should like to correct one statement which Mr. Fletcher had made with regard to the Sun gas-making machine, which he was sure was made inadvertently, but which was calculated to give a wrong impression. As the inventor of that machine, he begged to state that it did not contain a particle of any fibrous material, and he believed it was the first machine of the kind in which no fibrous material to dissolve the gasoline was used. From Mr. Fletcher's description of his carburetter, it seemed very similar to the generality of apparatus used for that purpose.

Mr. Jones asked if the coffee-roasting machine was made for sale.

Mr. Fletcher said he must refer to the patentees, Messrs. Bonser, for an answer to that question. He had made the patterns for them, and that was all he knew about it. He wished to add that the gas supply was not nearly so good as he had expected, and some of the experiments, in particular the musical chimnies, had not succeeded so well as they should in consequence. In reply to a question whether the blowpipes could be used with a fan as well as with a blower, he said it could be done by enlarging the air way. The one he had been using was made for a high pressure blast, the object being to get a powerful burner with a small foot blower.

A Member asked what was the durability of the casings; how long would the material last?

Mr. Fletcher said it depended on the temperature to which it was exposed. You could easily get a temperature which would fuse anything, but if you did not go beyond the temperature necessary to fuse nickel, which was approaching a blue heat, the casings would stand practically an unlimited time. He had worked them day after day, and all day long, at a blue heat—beyond a white heat. One casing had been worked at blinding white heat for a week, ten hours a day. He believed there was no other furnace which would stand that heat for such a length of time without coming to pieces.

The Secretary asked Mr. Fletcher how he arrived at his figure of 1s. 2d. per cwt. as the fuel value of the gas. It was said that from one ton of coal, partly cannel and partly ordinary, there were produced, besides the residual products, 10,000 cubic feet of gas, and this was calculated at 1s. 2d. per cwt. as a liberal allowance for its fuel value. He wished to know how that figure was arrived at.

Mr. Fletcher thought he was exceedingly too liberal to the gas companies in giving that figure. He judged by Manchester, where coal was worth about 6d. per cwt., and that if he allowed more than double that as the fuel value, he gave a large margin. The figures were of necessity vague, because there were no known data which would give an exact result. However, he did not come to speak on theoretical or chemical matters, but to put before them the practical use of gas as fuel. The figures were simply a rough approximation.

The Chairman then proposed a cordial vote of thanks to Mr. Fletcher for his most interesting and instructive lecture.

Mr. William Botly begged leave to second the motion. Knowing something of the manufactures of the country, he considered that everyone interested therein was very much indebted to Mr. Fletcher for his paper, and for the beautiful experiments with which it was illustrated. To the steel manufacturer this system would prove a very great boon indeed, for in the paying, smelting, and welding of steel it would be most useful. The goldsmith and silversmith would also be greatly assisted by it, and so would the enameller. Those who had seen that beautiful work carried on at Messrs. Elkington's, or at Christofle's, in Paris, would recognise at once how important it was to have such a ready and efficient means of obtaining an efficient heating apparatus. In culinary and general domestic purposes also, it gave promise of great economy, and lastly, it seemed to be very useful in the roasting of coffee. As many would remember, coffee was formerly roasted in something like a frying-pan; then came Savage's process, the cylindrical, which was a great improvement, and lastly came Dakin's silver coffee-roaster, which was also cylindrical. He thought the community at large, and the various trades he had mentioned in particular, were much indebted to Mr. Fletcher for the assistance he had rendered them in their various operations.

The motion was carried unanimously.

PRACTICAL EXAMINATION IN VOCAL OR INSTRUMENTAL MUSIC.

An Examination for the above purpose will be held at the House of the Society of Arts, during the week commencing 7th of June.

Candidates must send a certificate from a professor or other trustworthy authority, to the effect that their qualifications are such as to afford a

reasonable chance of their passing. Candidates who were examined last year need not again comply with this regulation. There is no limit in respect to age, occupation, or position.

At the conclusion of the Examination of candidates for the First or Second-class Certificates, the Examiner will record the result, with the marks in each section, on a numbered card, and hand the same to the candidate. The examination of the worked papers in the Honours Grade will necessitate some delay, but the result of this Examination will be conveyed to the candidates in due course.

The Certificates will be prepared as soon as possible after the Examinations, and can be had, upon application at the House of the Society of Arts, on or after the 2nd August, on presentation of the numbered card.

The Council will provide a grand piano and harmonium, and, if necessary, obtain the use of an organ, should candidates for examination on that instrument present themselves. Any other instruments must be brought by the candidates. The services of an accompanyist will be obtained when candidates for singing are to be examined.

The examination for Honours (including the working of the paper) will occupy three hours and a half. That for First or Second Grade Certificates about a quarter of an hour.

The examination of each candidate will be private; no one but the examiner and the accompanyist being present, unless it be a member of the Society of Arts' Committee; candidates will, however, be permitted to bring their own accompanyist.

The candidate will be known to the Examiner by a number only; and no list of candidates will be published.

The following are the conditions laid down for the three grades:—

Honours.

The Examination in Honours will consist of three sections, viz., a paper to be worked, an examination similar in form to the practical examination for a First and Second-class, and a *viva-voce* examination.

The paper will comprise:—

[1.] Harmony in four or five parts, each part to be written in its proper clefs.
[2.] Simple counterpoint in the five species.
[3.] Elementary form.
[4.] Instrumentation.
[5.] Questions on the history of music.

Text-books suggested:—Dr. Hullah's work on Harmony (Longmans); Dr. Stainer's work on Harmony (Novello); Dr. Hiles on Counterpoint (Forsyth, Manchester); Dr. Macfarren on Counterpoint (Cambridge University Press); "Form and Instrumentation," by W. A. Barrett (Rivingtons).

The maximum number of marks will be 100.

For a First-class in Honours, candidates must obtain 80 marks.

For a Second-class in Honours, candidates must obtain 60 marks.

Below 60 no Certificate will be granted.

Candidates must pay a fee of 10s., which will include both vocal and instrumental music.

First and Second-class.

Vocal.

Candidates for a First or Second-class Certificate in Vocal Music will be required—

[1.] To sing a solo, or to take part with another candidate in a duet, already studied. Credit will be given for the choice of the piece sung.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds, or successions of sounds, played or sung by the Examiner in that key, and in the keys connected with it; *e.g.*, the dominant, subdominant, relative minor, or other.

[3.] To sing or sol-fa at sight passages selected generally from classical music.

Candidates must come provided with a second copy of the solo or duet they have studied, in the established notation.

The maximum of marks is 100. These will be distributed amongst the subjects of examination in the following proportion:—

Marks.

Voice....20 per cent.	Ear.....20 per cent.
Style....20 ,,	Reading ..40 ,,

Candidates who obtain 75 marks will be entitled to a First-class Certificate; and those who obtain 50 to a Second. Candidates, the number of whose marks is below 50, will be entered as "not passed."

Instrumental.

Candidates for a First or Second-class Certificate in Instrumental Music will be required—

[1.] To play a piece already studied. Credit will be given for the choice of the piece played.

[2.] A key-note being sounded and named by the Examiner, the candidate to name sounds, played by the Examiner in succession or in combination, in that and its relative keys; *e.g.*, the dominant, subdominant, relative minor, or other.

[3.] To play a piece or portion of a piece at sight.

The maximum of marks is 100. These will be distributed among the subjects of examination in the following proportion:—

Marks.

Execution..20 per cent.	Ear.....20 per cent.
Style .....20 ,,	Reading ..40 ,,

Candidates who obtain 75 marks will be entitled to a First-class Certificate; and those who obtain 50 to a Second. Candidates, the number of whose marks is below 50, will be entered as "not passed."

The fee is 5s. for a First or Second-class (vocal or instrumental) Certificate. If vocal *as well* as instrumental music be taken by the same candidate for the First or Second-class Certificate, a fee of 7s. 6d. must be paid.

Candidates who hold certificates of last year can again be examined, with a view of obtaining a Higher Grade.

Similar Examinations will be held at the Birmingham and Midland Institute, and at the Association for the Higher Education of Women at Glasgow.

MISCELLANEOUS.

ARTISTS' COLOURS.

The following letter, by Mr. Simpson, on the subject of Mr. Holman Hunt's paper, printed in last week's *Journal*, appeared in the *Times* of the 26th inst:—

Sir,—All who heard Mr. Holman Hunt's admirable lecture on colours at the Society of Arts must have been impressed with the great importance of the subject, not only to artists themselves, but to the purchasers of pictures. Your leading article most graphically illustrated its bearings. The further discussion of the subject at the Grosvenor Gallery is most fitting; but there is one point which can be better ventilated in the columns of the *Times* than in any other place, and that is as to who should take up the practical experiments which the lecture showed was so necessary. It seems to me that the Royal Academy is the proper body to take upon itself the proposed functions. It is no trifling matter that is wanted. Not only should every pigment, both in oil and water colours, be used, and painted slips exposed to various degrees of light, but combinations of each should also be experimented upon, and all these should be carefully indexed, with regular reports made on their condition from time to time, not for a few years, but for centuries. The real value of the experiments in most of the pigments would not begin till at least half a century had gone past. The quantity of slips needed for this part of the work alone would require a large and very carefully selected space for their proper exposure, as well as a scientific official to make regular records connected with them; and extending, too, over such an indefinite period of time, it is all but certain that none but an official body like the Royal Academy could accomplish the work in the manner it ought to be done. A museum of materials is also one of the demands. In addition to colours, there are oils and varnishes, as well as the priming of various grounds to paint on. The water-colour men would also want to know something of their colours, as well as the gums and other ingredients mixed with them. Mr. Hunt says there is no paper fit for water-colour painting now made. To paper you have to add canvas and panels. To this there are also the materials connected with the newly grown up taste for painting on tiles and ceramic ware of all kinds. This slight enumeration of what has to be accomplished will suggest how vast the field of labour must be, and it can be but of small value unless it is most carefully and systematically continued for a long period of time. The work is so vital to art that it ought to be looked upon as national, and this points to the Royal Academy as the institution whose business it is. If the Royal Academy refuse to take the matter up, then by all means let us have the society Mr. Hunt proposes. This is not likely to be the case; the Royal Academicians must be as anxious about the quality of the colours and canvases they use as any men can be; their appointment of a Professor of Chemistry may be cited as evidence in this direction. It would be well for Mr. Barff to let it be known to what extent his duties are likely to realise what has been indicated by Mr. Hunt's lecture, and for the Academy to say how far they are willing to go in working out what is required.

I am, Sir, yours obediently,

64, Lincoln's-inn-fields, April 24. William Simpson.

This elicited the following letter from Mr. Holman Hunt, which appeared in the *Times* of the 28th inst.:—

Sir,—It is, I feel, natural that many should assume, as Mr. William Simpson does in his letter appearing in the *Times* of to-day, that the Royal Academy is the proper institution to take up the duty of improving our supply of materials, and increasing the knowledge of them among painters. I once thought so; but I have long been convinced that the existing duties of the members are too arduous, and their aims too elevated, to allow them to undertake an additional labour, so much requiring patient, inglorious watchfulness as would the task proposed. This mistaken conception of the nature of the Royal Academy has, probably, long deterred many besides myself from taking measures for remedying the existent evil.

When the Royal Commissioners took evidence as to the actual condition of the Royal Academy, and, in sitting, had to consider whether means existed of making it a more perfect guardian of art interests, I ventured, in giving my evidence, to recommend that a chemist should be appointed by the institution to put our knowledge of pigments on a solid basis. Mr. Salter, it seems, advised the same course, and soon after the latter wrote, the Royal Academy appointed Mr. Barff as professor of chemistry. Both before and after my first public utterance I urged on many Academicians, whom circumstances enabled me to worry, that the business which seemed to me so vital should be taken up practically and thoroughly. For long, now, I have recognised that what one long-standing member replied is true, that "such work is far beneath the dignity of the Royal Academy." The fact that from the foundation of the institution to this date it has never committed itself to such humble duties is a proof that it was not right to expect this body to undertake them now. The appointment of Mr. Barff did not, I am, if necessary, able to show, note any departure from the higher traditions of the Academy. It was a gracious concession to the prejudices of the public, such as all great powers are at times wise in making; and, this being recognised, we outsiders, with a craze for attaining our unfashionable object of security in the character of materials, would have been foolish any longer to delay independent measures for securing our end. The new society cannot now consent to being supplanted. We have not formed ourselves simply for the pleasure of having after-dinner assurances that all is better than well. The gentleman who advises that we should trust to the Royal Academy to carry out our purposes will, I think, on further reflection, recognise that the institution which, agreeably to all its traditions, avoided attention to a crying want as one not appealing to itself, cannot suddenly be expected to change its whole nature and attend heartily to matters which a rival faction brought to its unwilling notice.

When the pressing business of hanging the exhibition at the Grosvenor Gallery is fully despatched, a day shall be fixed for the proposed discussion.

I am, Sir, yours obediently,

W. Holman Hunt.

Athenæum Club, Pall-mall, April 26.

THE PRODUCTION OF INDIGO IN BENGAL.

Indigo is almost entirely obtained from leguminous plants of the genus *Indigofera*, that cultivated in India being the *Indigofera tinctoria*, and that in America the *Indigofera anil*. The plant is grown in India, China, Java, the Antilles, and Central America. It is planted either in the spring or the autumn, and generally in a clayey soil. In India it has pinnate leaves and a slender ligneous stem, and, when successfully cultivated, rises to the height of 3, 5, and 6 feet. It is cut with pruning knives at the end of May, and as its growth is exceedingly rapid, two, and sometimes three crops are obtained, but the last crop, in its production of colouring matter, is not equal to the first. Mr. Kœchlin-Schwartz, in an article in the *Bulletin de la Société Industrielle de Mulhouse*, gives some interesting particulars of the preparation of indigo in Bengal.

In this province of India, the indigo factories—in addition to filters, presses, a boiler, drying grounds, and reservoirs—are provided with two rows, each consisting of 15 to 20 vats. These vats are constructed of brickwork, and covered over with a strong coating of stucco; they are generally from 18 to 20 feet square, and about three feet deep; the back row is nearly three feet higher than the front, and it is in the higher row of vats that the fermentation takes place. When the fermentation is completed, the liquid is turned off, and flows into the lower vats. The water of the Ganges, which is comparatively pure, and therefore well adapted for the purpose, is utilised in this process.

In the morning the plant is cut, taken to the factory, and loaded in the vats in the evening, one vat containing 100 packages or bundles, arranged in layers, on the top of which are placed transverse pieces of wood tightly wedged down, it being necessary that the plants should be well pressed, or the fermentation would not otherwise thoroughly take place. Water is then allowed to flow into the vats until the plants are submerged. The process of fermentation lasts from nine to fourteen hours, but depends entirely upon the temperature. To test the progress of the operation, a little of the liquid is drawn off into the lower range of vats; if it is of a pale straw colour, the quantity produced will not be so abundant, but it will be of a superior quality than when the colour is of a deeper yellow tinge. The colour of the liquid after fermentation, and when it is drawn off, is always more or less of a deep yellow. It is allowed to remain some little time, then the water, while still warm, is beaten by twelve naked men armed with long bamboos. While this is going on, the higher range of vats is being emptied and cleared for another supply of the plants, seventeen workmen being employed in cleaning one vat. The liquid is beaten for two or three hours, and gradually becomes of a pale green colour, and the indigo forms into small flakes; it is allowed to remain half-an-hour, and the water is then turned off gently, corks placed at different levels in the vat being one by one withdrawn. The water returns to the river, and the deposit, which resembles a thin scum, is carried through a trough into a deep trench. By means of a hand-pump, it is then brought up and boiled for a short time in order to prevent a second fermentation—which would cause it to turn black and be spoiled. It is allowed to remain about twenty hours, and then the boiling process is again resorted to, which continues for three or four hours, when the boiling mass is poured off and strained through a filter. This filter is composed of a brick vat covered with stucco 18 to 20 feet long, six feet wide, and about three feet deep; it is covered with bamboos, on which are spread rush mats, and over these a strong, well stretched linen cloth. On this cloth, after the liquid has been strained through, there remains a thick, deep blue paste, almost black.

The water which was in the vat, in flowing through the filter, leaves this deposit of indigo. The paste is then placed in small, solidly constructed wooden cases, perforated with small holes, and with a very strong linen cloth at the bottom; the cases are then covered with cloth, and a wooden lid perforated also with small holes; they are then pressed in a vice to extract every particle of moisture. When this operation is completed, the indigo is found in a large thick block, the cutting of which demands careful attention, and must be done very slowly. The blocks are then submitted to the action of the drying-ground, which consists of a large brick building of a good height, with windows furnished with closed lattices to exclude the rays of the sun, even thick bushy trees being planted all round the buildings to assist in keeping out the light. The cakes occupy from three to five days in drying, and are then sent to Calcutta. It is in this state that indigo is delivered into the market; its quality may be tested by its lightness or small specific gravity, and its bright colour when rubbed with the nail.

GENERAL NOTES.

Technological Examinations.—The returns already received for the Technological Examinations of the City and Guilds Institute show that over 1,000 candidates will present themselves for examination at 80 centres. This is a very large increase on last year, when only 202 were examined. The examinations are to be held on the evening of the 12th May, concurrently with the examination of the Science and Art Department on that evening.

Brussels Permanent International Exhibition.—Besides the purely national Exhibition in the Champ des Manœuvres, Brussels, an International Exhibition, intended to be permanent, is announced for opening on 1st May. It is to be held in the Palais du Midi, a large and imposing structure, well adapted to its purpose, situated between the Boulevard du Hainault and the Avenue du Midi, the latter of which forms direct communication between the two termini of the Belgian capital. All articles for exhibition are to be in the building by 15th April, and a committee of patronage will determine their classification and arrangement, so as to add to the general effect. All articles of an artistic, industrial, or commercial character are admissible, but those of a dangerous nature are rigorously excluded. A charge is made of £2 per square metre of ground space and £1 per square metre of wall space for the whole year, and the management offer to let at a small charge stands or show-cases of four different types. Motive power, gas and water, are provided; and conferences, congresses, and lectures are to take place at intervals during the year. Further information, with prospectuses, and plans, and sections of the building may be obtained of the Administrateur-Directeur, M. Ernest de Bavay, Palais du Midi, Brussels.

Fireproof Materials.—In the report published by the *Journal* on the Applied Science Exhibition, Paris, of last year, mention was made of the muslin curtains shown by M. A. J. Martin, Paris,* to which a flame was constantly applied without consuming them. The composition he employs for rendering inflammable paper, wood, and textile fabrics is the following:—

	Parts.
Pure sulphate of ammonia	80
Carbonate of ammonia	25
Boracic acid	30
Pure borax	17
Starch	20
Distilled or pure water	1,000

The materials are dipped in this solution while hot, so as to be thoroughly impregnated, when they are dried sufficiently to be ironed in the same way as ordinary starched fabrics.

* 30th January, 1880, p. 187.

Sand Distributor.—Messrs. Garret's Sand Distributor, a machine for the purpose of delivering sand over roadways with perfect regularity, will be exhibited in action on the Thames Embankment, in the neighbourhood of the Chelsea Suspension Bridge, on Friday, May 7th, at 2.30 p.m., when members of the Society of Arts are invited to attend.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock:—

May 5.—"Agricultural Experience: the Lesson of Forty Years." By John C. Morton. James Caird, C.B., F.R.S., will preside.

May 12.—"Utilisation and Properties of Blast Furnace Slag." By Charles Wood.

May 19.—"Trade Routes between England, Norway, and Siberia." By Lieut. G. T. Temple.

Indian Section.

Friday Evenings, at Eight o'clock:—

May 7.—"The Present Condition and Prospects of Agriculture in South India." By W. Robertson, M.R.C.A., Superintendent of the Government Farms in the Madras Presidency. Sir William Rose Robinson, K.C.S.I., will preside.

May 14.—"China and the Chinese: their Early History and Future Prospects." By A. Terrien de La Couperie. Professor Robert K. Douglas will preside.

Foreign and Colonial Section.

Tuesday Evenings, at eight o'clock:—

May 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. James Sibree, Jun., F.R.G.S.

Applied Chemistry and Physics Section.

Thursday Evenings, at eight o'clock:—

May 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. Adams, F.R.S. William Spottiswoode, LL.D., Pres. R.S., will preside.

May 20.—"Some Recent Advances in the Science of Photography." By Captain Abney, R.E., F.R.S.

Cantor Lectures.

Monday Evenings, at Eight o'clock.

The Third Course, by R. W. Edis, F.S.A., on "Art Decoration and Furniture."

Lecture V.—May 3.

The Drawing-room and Boudoir, Bedroom, and Offices.—General treatment. Colouring and decoration. Lacquer work. Gilding. Furniture and hangings.

Lecture VI.—May 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Members can admit Two friends to each of the Ordinary and Sectional Meetings, and One friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

Additional Lectures.

May 6th, 4 p.m.—Lecture by Dr. B. W. Richardson, F.R.S., on "Fleuss's New Diving Apparatus." Practical demonstration of the working of the apparatus will be given by Mr. Fleuss.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 3rd...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture V.)
Farmers' Club, Inns of Court Hotel, Holborn, W.C., 4 p.m. Mr. A. Crosskill, "How Far are the Interests of Landlords and Tenants Identical."
Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Graham Smith, "The Design and Construction of the Tay Bridge."
British Architects, 9, Conduit-street, W., 8 p.m. Annual General Meeting.
Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Rev. H. G. Tomkins, "The Life of Joseph: Illustrated from Sources External to Holy Scripture."

Tuesday, May 4th...Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. H. Scott, "Wind and Weather." (Lecture III.)
Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. "The Amsterdam Ship Canal."
Pathological, 53, Berners-street, Oxford-street, W., 8¾ p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m.

Wednesday, May 5th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. John C. Morton, "Agricultural Experience: the Lesson of Forty Years."
Entomological, 11, Chandos-street, W., 7 p.m.
Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Thursday, May 6th...Linnean, Burlington-house, W., 8 p.m. 1. Prof. E. Ray Lankester, "The Extinct Walrus of Suffolk and Antwerp." 2. Prof. G. Dickie, "Algae from the Amazon and its Tributaries." 3. Prof. P. M. Duncan, "An Unusual Form of the Genus *Hemipholis*, Agass from off the Algulhas Bank." 4. Mr. Chas. Stewart, "Irregularity in a Species of *Amblypneustes*."
Chemical, Burlington-house, W., 8 p.m. 1. Dr. Hodgkinson, "The Action of Sodium on Ethereal Salts of Phenyl Acetic Acid." 2. Mr. C. E. Groves, "Estimation of Nitrogen in Carbon Compounds." 3. Mr. M. P. Muir, "Sage Oil." 4. Dr. W. Ramsey, "The Electrical Conductivity of Solutions."
South London Photographic (at the House of the Society of Arts), 8 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture V.)
Inventors' Institute, 4, St. Martin's place, W.C., 8 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. W. T. Butler, "A Small Colliery in North Wales."
Archæological Institution, 16, New Burlington-street, W. 4 p.m.

Friday, May 7th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. W. Robertson, "The Present Condition and Prospects of Agriculture in South India."
Royal United Service Institution, Whitehall-yard, 3 p.m. Captain Walter H. James, R.E., "Modern Rifle Fire; its Influence on Armament, Training, and Tactics."
Royal Institution, Albemarle-street, 9 p.m. Prof. Flower, "Fashion in Deformity."
Geologists' Association, University College, Gower-street, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. 1. Mr. C. B. Cayley, "A Difficulty in Russian Grammar." 2. Mr. Benjamin Dawson, "Quicherat's Latin Etymologies."

Saturday, May 8th...Physical, Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution. Albemarle-street, W., 3 p.m. Prof. H. Morley, "The Dramatists before Shakespeare."

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FRIDAY, MAY 7, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

LONDON WATER SUPPLY.

The Council have decided to summon a public Conference, to consider the question of supplying London with pure water. At present the date for the Conference has been fixed for Monday, the 24th inst., but it may be found necessary to alter this date. The arrangements for the Conference are now being considered by a Committee, and full announcements will be made as early as possible. The following Committee has been appointed:—F. A. Abel, C.B., F.R.S., F. J. Bramwell, F.R.S., Edwin Chadwick, C.B., Lord Alfred S. Churchill (Chairman of the Council), Sir Henry Cole, K.C.B., Major-General F. Cotton, R.E., C.S.I., Edward Frankland, D.C.L., F.R.S., Capt. Douglas Galton, C.B., F.R.S., and the Right Hon. James Stansfeld, M.P. As soon as a programme has been prepared by the Committee, it will be published and advertised. Copies, when ready, can be had on application to the Secretary.

REPORT OF EXAMINATION COMMITTEE.

The Council have had before them two memorials, one from the Yorkshire Union of Mechanics' Institutions, and the other from the York Institute of Popular Science, asking them to reconsider their decision of not holding in future any more Elementary Examinations. The Council referred the question to the Examination Committee, which reported thereon as follows:—

"The Examination Committee, having considered the Memorials from the Yorkshire Union of Mechanics' Institutes, and the York Institute of Popular Science, referred to them by the Council at their meeting on the 12th inst., beg leave to report as follows:—

"They find that the total cost to the Society of the Elementary Examinations in 1879, the last completed year, was £22 6s. 6d. The examinations were held at ten centres, 2,519 sets of papers were sent out, and 768 candidates were passed. Having regard to the fact that the cost of these examinations is so very slight, and that they appear to be considered valuable by the persons for whose benefit they were instituted, the Committee think that the Council would act wisely in continuing them for the present, at all events, until such time as their place may be taken by some other organisation.

"In making this recommendation, the Committee see no reason to modify the opinion they expressed in their former report, presented to the Council in July last, with regard to the other Examinations of the Society. The Elementary Examinations, however, stand on a different footing from the rest, and they think that the Council would do well to continue them for the present."

The Council have accordingly decided to act on the recommendation of the Committee, and they therefore wish to draw the attention of Secretaries of Institutions in Union with the Society to the fact that the Elementary Examinations will, for the present, be continued on the same footing as heretofore.

CANTOR LECTURES.

The fifth Lecture of the third course of "Cantor Lectures" on Art Decoration and Furniture," was delivered by R. W. Edis, F.S.A., on Monday, the 4th inst., when the lecturer specially considered the treatment of the Drawing-room and Boudoir, Bedroom and offices. Specimens of paperhangings silks, tapestries, embroidery, and leathers for walls were exhibited by Messrs. Crace and Co. Paperhangings by Messrs. Scott, Cuthbertson, and Co., and a cabinet, table and chairs by Messrs. Jackson and Graham. The lectures will be published in the *Journal* during the summer vacation.

TWENTIETH ORDINARY MEETING.

Wednesday, May 5th, 1880; JAMES CAIRD, C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Adams, William Alexander, Walford Manor, Shrewsbury.
Allhusen, Alfred, Gateshead-on-Tyne.
Aveling, Thomas, Boley Hill-house, Rochester, Kent.
Beckingsale, George, Ferndale, Wanstead, Essex.
Bridge, Frederick A., 207, East India-road, E.
Clay, Sir Arthur T. F., Bart., Barrows-Lea, Shere, Guildford, Surrey.
Davison, Charles Edward, Trentham-house, Twickenham-park.
Marshall, William, F.R.G.S., 37, Norfolk-street, Strand, W.C.
Marston, Edward, 19, Highbury-crescent, N.
Matheson, Hugh Mackay, 3, Lombard-street, E.C.
Rees, Thomas Henry, 196, Westminster-bridge-road, S.E.
Schmidt, Conrad Marshal, 49, Kingsdown-road, Upper Holloway, N.
Utley, Samuel, 10, Norfolk-place, Halifax, Yorks.

The following candidates were balloted for and duly elected members of the Society:—

Barrington, Viscount, 19, Hertford-street, Mayfair, W.
Batten, John Winterbotham, 3, Harcourt-buildings, Temple, E.C., and 35, Palace-gardens-terrace, Kensington, W.
Cadogan, The Earl, Chelsea-house, Cadogan-place, S.W., and Babraham-hall, Cambridge.
Da Costa, David Campbell, Porchester-gardens, W.
Davy, David, Sharrow Knoll, Sheffield.
Dent, Edward, 61, Princes-gate, S.W.
Devlin, James, 2, St. James's-villas, Urswick-road, Lower Clapton, E.
Ferrers, The Earl, Staunton Harold, Melbourne, Derby.
Hardwicke, The Earl of, Horseneath-lodge, Linton, Cambridge.
Ilchester, The Earl of, 42, Belgrave-square, S.W.
Mackey, J. A. D., 5, King's Bench-walk, Inner Temple, E.C.
Pembroke and Montgomery, The Earl of, Wilton-house, Salisbury.
Smith, George John, Trevu, Camborne, Cornwall.
Watson, William Livingstone, 21, Buckland-terrace, Belsize-park, N.W.

The paper read was—

AGRICULTURAL EXPERIENCE: THE LESSON OF FORTY YEARS.

By J. Chalmers Morton.

This paper proposes to discuss the agricultural experience of the past forty years, to give pictures of certain portions of it, and to draw certain lessons from it. First, then, of the experience; next, of the pictures; and lastly, of the lessons.

1.—Personal Experience.

My first bit of agricultural experience occurred in 1837—then a student in the agricultural classroom of the Edinburgh University—when I was instructed to examine and describe the operations of thorough drainage and subsoil ploughing, which the late James Smith, of Deanston, near Stirling, was directing on a farm, much of which had been but lately brought in from moorland. The key-note of a general concert of agricultural enterprise was at that time struck; and a period of very extensive agricultural improvement then began. I was over the same farm last autumn after an interval of 42 years, and was delighted to find how well Mr. Smith's promises have been fulfilled, and how perfectly the fertility which he had stimulated and enabled, is maintained. One of his main drains and several of his minor drains lay open for my inspection, and I could see in them how admirably thorough the execution of his work had been.

Coming home to Gloucestershire in 1839, I was sent by my father, who was agent to the late Earl of Ducie, to Whitfield-farm, in the Vale of Berkeley, where I remained till 1852, first as a learner, then as a manager, and lastly, as co-tenant, and receiving pupils. This was the so-called Whitfield example farm, where the Deanston system was carried out, and where the systematic cultivation of some 250 acres, which had been in 60 small fields, mostly grass, was thrown open to the public—many thousands of whom visited it for the sake of the illustrations which it gave of good estate equipment, of what was then called deep drainage

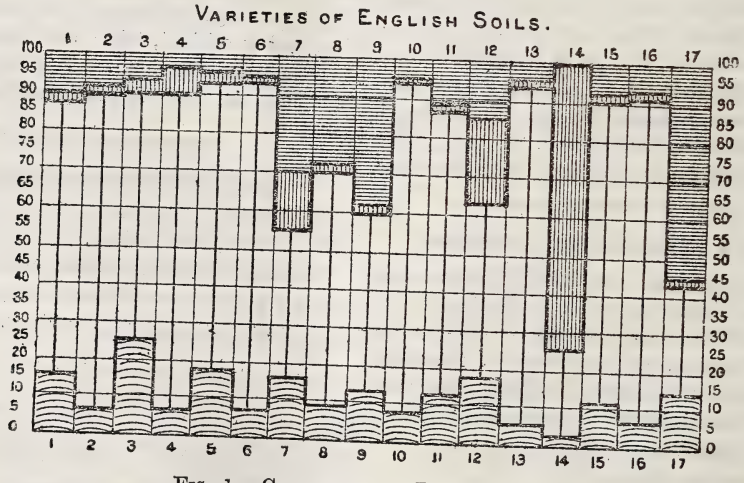


Fig. 1.—Composition of English Soils.

Each column is in four sections—the top section representing the per-centage of organic matter present—the next one with vertical shading the lime—the bottom layer the clay, and the middle open space the sand.

and subsoil ploughing, and of the use of guano, nitrates, and large purchases of cattle foods.

In 1843, I was appointed editor of the weekly *Agricultural Gazette*, an office which I have now held for 1,900 consecutive weeks; and for the last 37 years it has thus been my business to describe whatever was occupying the attention of the agricultural world, to report upon the successive steps which agricultural progress has taken, and to make known the results of current scientific investigation and practical experiment to agricultural readers. The main object, however, of that journal has been, not that its editor should teach its readers, but that its readers should teach each other, and accordingly it has long been written every week by thirty or forty contributors in twenty different counties, so that I

have been in constant communication with agricultural workers and agricultural writers all over the island.

Between 1849 and 1854, I had the honour of guiding a team of upwards of 60 of the best agricultural writers of the day, one of whom is your Chairman this evening; and amongst us we produced the *Cyclopædia of Agriculture*, published by Messrs. Blackie, which accurately reported the best agriculture of its day. In 1862, having repeatedly examined various schemes for dealing with the sewage nuisance, which had been growing ever since the invention of the water-closet, I visited all the sewage farms then in operation, and gave evidence on the subject before Dr. Brady's Select Committee of the House of Commons; and in 1866, the Lodge-farm, near Barking, was placed under my management, to lay out and cultivate under sewage irrigation, by the Metropolitan Sewage Company, which had just then been incorporated by Act of Parliament. Two years later, having acquired some practical knowledge and experience of the agricultural remedy for the sewage difficulty, I was appointed on the Royal Commission of Inquiry into the Pollution of Rivers, and thus had admirable opportunities of witnessing the condition, not only of most of our large manufacturing towns, but of extensive areas of country within many of the largest and most important of the river basins of England and Scotland.

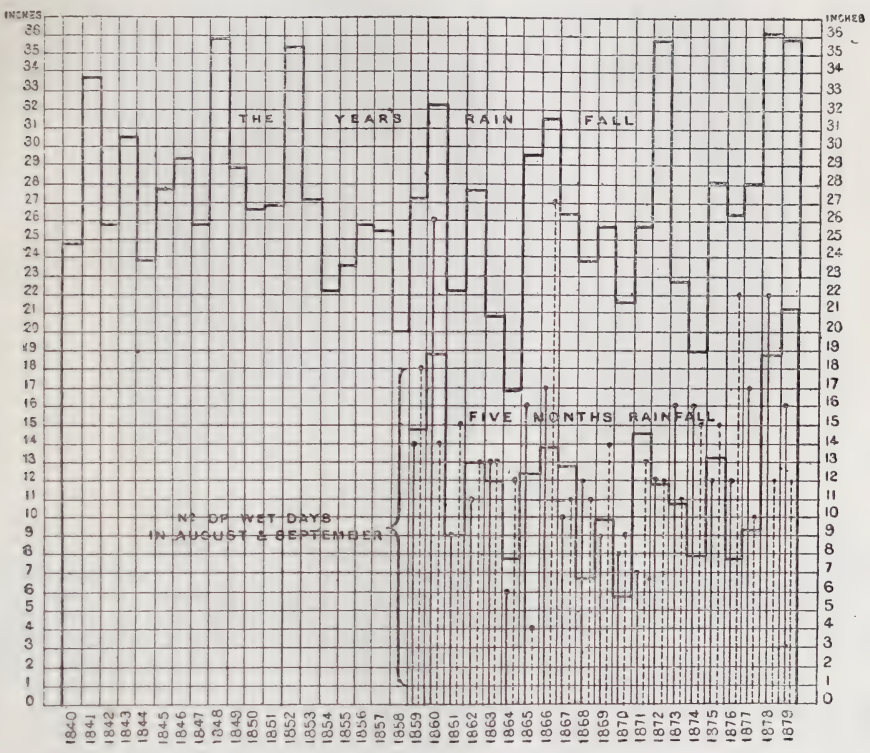


FIG. 2.—THE RAINFALL.

The rainfall of the year, and of the five months after May 1; also the number of wet days in August and September respectively in each year.

During the last twelve years I have acted as an inspector under the Lands Improvement Acts, and under Mr. Caird and his colleagues on the Inclosure Commission, by whom these Acts are administered. In that capacity I have reported, in more or less detail, on the agricultural condition of more than 100 estates, covering upwards of 160,000 acres, or 250 square miles, in many different counties—on which proposals for improvements, amounting in all to more than £300,000, have been considered. And of this large sum I have witnessed and certified the expenditure of close on a quarter of a million of money—about £200,000 in homesteads and farm cottages, and the rest in land drainage, roads, and fences. Here, again, I have had unrivalled opportunities of becoming personally acquainted with the agricultural condition of large areas of land in this country, especially of the settled estates on which these large outlays have been made.

To this I will add that I have all my life been resident in villages and country places—in Gloucestershire, Berkshire, Middlesex, and Hertfordshire—never in towns; so that I thus claim habitual and familiar acquaintance with the neighbourhoods and relationships of all classes in country life—farmers and their labourers, landlords and their tenants, clergymen and their parishioners.

I may further add a reference to my successive reports to the Royal Agricultural Society of England (of which I have been a member since its

formation, and have attended 36 of its forty annual exhibitions); reports also to various other institutions having agricultural objects, the Society of Arts, the Bath and West of England Society, the London and other Farmers' Clubs; reports on the agricultural lessons of particular seasons, whether of excessive rainfall or of drought; reports on agricultural education, on agricultural machinery, on the milk supply to towns, on sewage farming, on the cost of horse power in agriculture, on farm competitions, on steam cultivation, on rural benefit societies, on the allotment system, on bad drainage, on the forces used in agriculture, on the maintenance of fertility in newly broken-up land, on the circumstances of agricultural maxima, and on the dairy husbandry of Great Britain—all these compilations and comparisons of wide agricultural experience, have helped to give me what I venture to say is an unusually extensive acquaintance with the circumstances of English agriculture. They have, in fact, helped to qualify me for my task this evening, and that is my excuse for this long narrative of personal experience.

Gentlemen, you have thought during the course of it that I was casting modesty to the winds; but my narrative has been necessary for my purpose, which is to add whatever urgency and weight I can—to claim whatever authority I may—for the

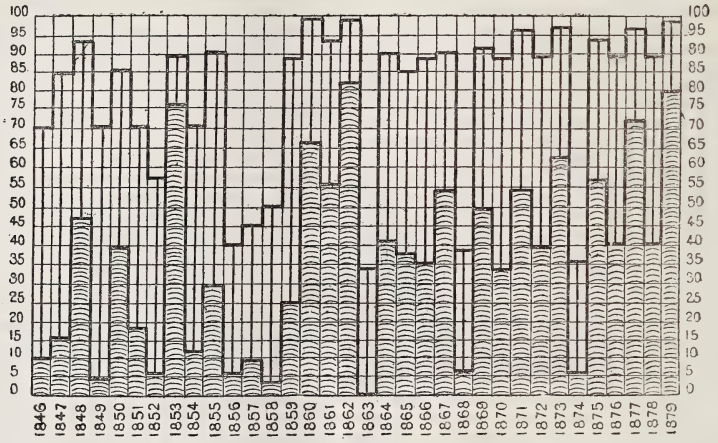


Fig. 3.—Character of English Harvests.

important lesson which I shall offer you, and which I contend is fairly drawn from the mass of facts epitomised in the diagrams before you. To these pictures of agricultural experience I shall now ask your attention.

2.—The Diagrams.

In order, however, that we may start with a due sense of the interest involved, let us begin with a definition of our subject, and with a statement of the chief lessons regarding it which I believe experience teaches, and which it is the object, therefore, of this paper to illustrate. Agriculture, apart from land owning, and apart from mere farm labour, is the occupation of upwards of 1,000,000 of our fellow-countrymen, who hire land, and employ labour, and use money, industry, and skill, in the creation, guidance, and conversion of fertility—in order to self-maintenance and profit. That is the ultimate and proper end and object of the occupation. If either profit or self-maintenance be impossible under it, the capital is withdrawn, the land is given up, the labourer is dismissed, the business is abandoned: *i.e.*, the particular hirer of land and employer of labour who has thus failed abandons it. Although, however, he has failed, another may succeed; and the vacant place will be once more filled, and someone will again risk capital, undaunted by the failure of his predecessor —encouraged, probably, both by alterations in the circumstances under which he is to work, and by alterations in the agencies and methods by means of which he means to work. He may hire his land for less money, or he may be less hampered by restrictions in the use of it. Whether he shall bring more capital into use or not, he will, at all events, try to bring more of qualities to bear which do not involve increase of capital—more skill, shrewder insight and foresight, more carefulness, more industry; and the labour which he employs may be more urgently and more skilfully directed — no more may be paid for it, but a good deal more may be got out of it. We too often see one man prosper as a farmer while another alongside of him is failing, to despair—because one man has failed on any farm—of another prospering who may follow him.

Objectively, then, and looked at by an outsider, agriculture is a business pursued for maintenance and profit by some 1,160,000 hirers of land in the United Kingdom; or, deducting all holders under 50 acres each, by about 350,000 tenant-farmers (I am taking the figures of our Chairman), who pay agricultural rent and employ agricultural labour. That is its definition by an outsider. In itself, essentially, subjectively, agriculture is the cultivation of soil, plant, and animal, in order to a maximum of useful products. Various in its character and objects all over the world, as are the climates and the soils—various in our own country too, as are our soils and our climates, its

results in every separate locality are fickle as is our weather, and sensitive to its influences as the living things which it cultivates necessarily are. They are liable to destruction by rainfall or by drought, by blight or by disease; and—by competition with the produce similarly uncertain of

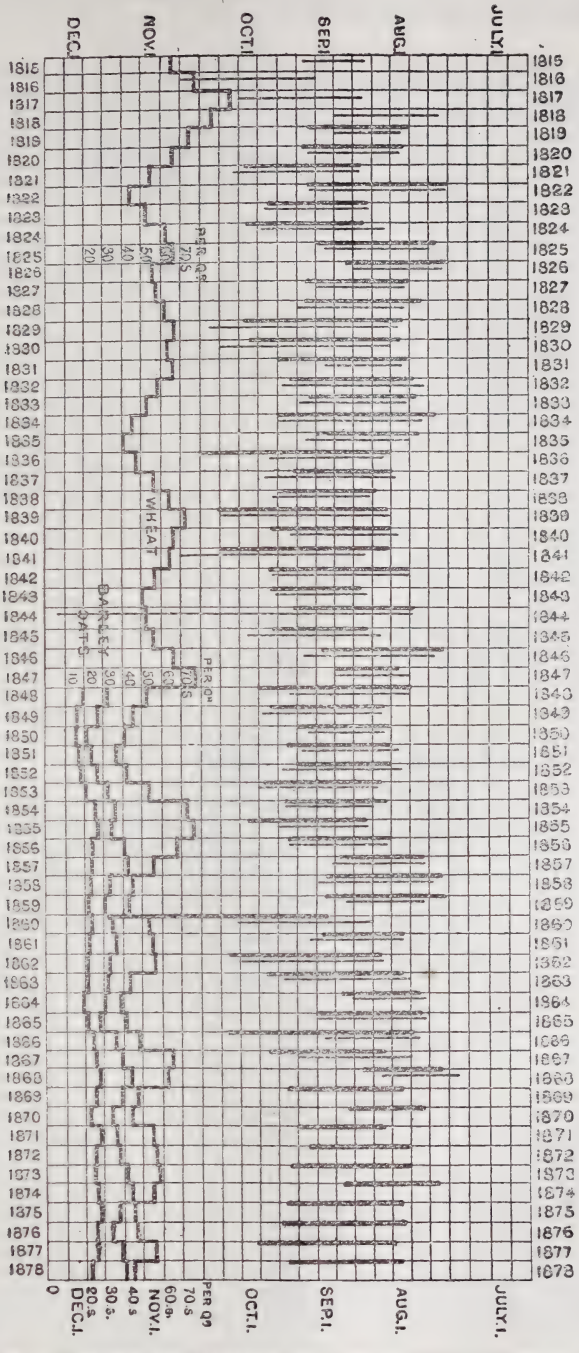


FIG. 4.—DURATION OF HARVEST AND AVERAGE PRICE OF GRAIN.

other countries—they are liable in the end to comparative worthlessness in the market. Whether, then, agriculture be regarded objectively and merely as the professional occupation of so many, or subjectively in relation to its processes and the quantity of its useful products—all these things, I may say, are against us.

And the lesson which I gather from the many

difficulties and uncertainties around us—the lesson that liberty of action is necessary, and that greater strength and intelligence are necessary for those who would successfully cope with them—this is the lesson which I hope that my paper will successfully illustrate.

I have gone to the writings of Dr. Voelcker, Professor of Chemistry to the Royal Agricultural Society of England, for illustrations of the variety of our soils, and to Mr. G. J. Symons, our best meteorological authority, for illustrations of the variety of our climate. And, for illustrations of the consequent variety of agricultural experience, I have gone to my correspondents in many English, Scotch, and Irish counties, and they have done me the very great honour of virtually entrusting to me their books, accounts, and statistics, from which they have made such extracts as I desired. I have not made detailed inquiry into such payments or receipts as would reveal farm losses or farm profits with precision; but you will see from my tables of figures, if you should come hereafter to read this paper, and from the diagrams in which their main features are represented on the wall, how fickle and various a thing is agricultural experience—how very much its losses or its profits may exceed even the sum total of the rent—how extravagant are the hopes which its maxima are apt to create—how desperate the plight in which a tenant-farmer must often think himself to stand, if, indeed, he knows, which is not always the case, the losses he has suffered. And it will there be also seen what need there is, here more than in any other manufacturing business, for both sharp insight and sharp outlook, for patience, intelligence, and enterprise.

For the next quarter of an hour, I will ask you to look at the diagrams on the wall, by which these lessons are, I contend, enforced. In the first place, on diagram No. 1, you see seventeen separate columns of equal height standing on a level line for their common base. These columns are divided into 100 parts a-piece, by figures on the two sides of the diagram, and each of them represents the composition of a separate soil. They are, for the most part, instances given by Dr. Voelcker, and the heights of the several colours in the several columns represent the per-centages of the several ingredients of which the several soils are composed. The vegetable matter in these soils, represented by the dark colour by which each column is capped, varies, you will see, from less than 1 to 55 per cent.; the clay, at foot, from very little up to 25; the sand, midway of the columns, from 40 to 95 per cent.; and the lime, from 1 to 75. The soils our farmers cultivate in this little island are in fact as various as is our geology, which you will see represented on any parti-coloured geological map of Great Britain. But it may be urged that, various as the soils may be, that of each farm, at any rate in its own particular case, is constant and unvarying. A man, for example, cultivating land whose composition is the same as that indicated in column No. 7 or 9, or 11 of this Table, having learned and practised the cultivation proper to its nature, finds the same rules, the same difficulties, the same facilities, the same results, year after year alike. On the contrary, this soil which one year he finds to be tractable and free, is another season wet, difficult, almost impossible to manage. The best soils, containing just alumina enough to make them loams, and the poorest clays, whose sand is as fine as their clay and their alumina in excess, are manageable or not just according to the weather, and that is unquestionably variable. The clays of Essex would have been all grass land, as they are in Gloucestershire, if the climate had been as wet in the east as it is in the west of the island; and when in any year the rainfall is as heavy and as constant in the east as it is in the west, the Essex farmer wishes, as he did last year, that his ploughed land had been all laid down to pasture, for he finds it almost impossible to cultivate it as arable.

And how variable the rainfall of the island, which, agriculturally, is the most important element in our climate; for a wet summer is always a cold one also, may be gathered from diagram No. 2. Here, on this upper irregular line, which may be read off in the figures at the side for each year whose column is crossed by it, you see the annual rainfall for the last 30 years at Camden-town, where it has been observed by Mr. G. J. Symons; and in a second line, crossing most of these annual columns, you see the amount of the five months' rainfall of each year, beginning with May 1, by which the fortunes of the wheat crop of the year may be said to be determined. This is a picture of only one locality, but what a variety of experience is thus revealed one diagram shows as well as twenty. Some districts are much wetter than others, and the whole style of farm management varies accordingly, but in every one there is this same variety. You have wet years, like 1879 and 1872; dry years, like 1864 and 1874; the height of the upper line by which the columns are cut off in each case indicating the number of inches of the rainfall. Or you have wet summers of five months following May 1, like 1878 and 1879, and dry seasons like 1868 and 1870; here also indicated by the height of the lower black line above the base. And lastly, look at the great difference in different years indicated by the heights of the black and dotted lines standing in the columns of the several years 1838 to 1868. These indicate the number of wet days in the month, during the two harvest months of August and September. They are read off on the figures on either side. Let me also direct you to the shaded bands crossing the diagram No. 3 at its foot. Here are a number of columns of equal height, each the harvest picture of its year. For the last 34 years I have collected in the *Agricultural Gazette* the reports of the harvests of each year, from 200 to 400 correspondents in different parts of the country. Each column exhibits the character of the reports of its year. Dividing each into 100 parts—the height to which its lower black portion extends indicates the per-centage of these reports which declared the harvest to be under average, while the extent of the upper red coloured portion of each column indicates the per-centage of these reports which declared the harvest to be over average. The extent of blue middle space in each column represents the proportion which reported the crop to be simply average. And you can see what variety of experience is represented here; and the variations correspond (not always, but very generally) to the rainfall of the year. When the rainfall has been less one year than another, as in 1870 compared with 1879, the over-average

per-centage of harvest reports increased; when the rainfall was excessive, as in the five months of 1879 as compared with 1868, the black, under-average character of the harvest increased.

This diagram, of which the various character is seen at a glance, is thus itself a picture of the fickleness of agricultural experience. In the short perpendicular lines, thick and thin respectively, in the several columns of the next diagram (Fig. 3), we have another illustration of variable experience,

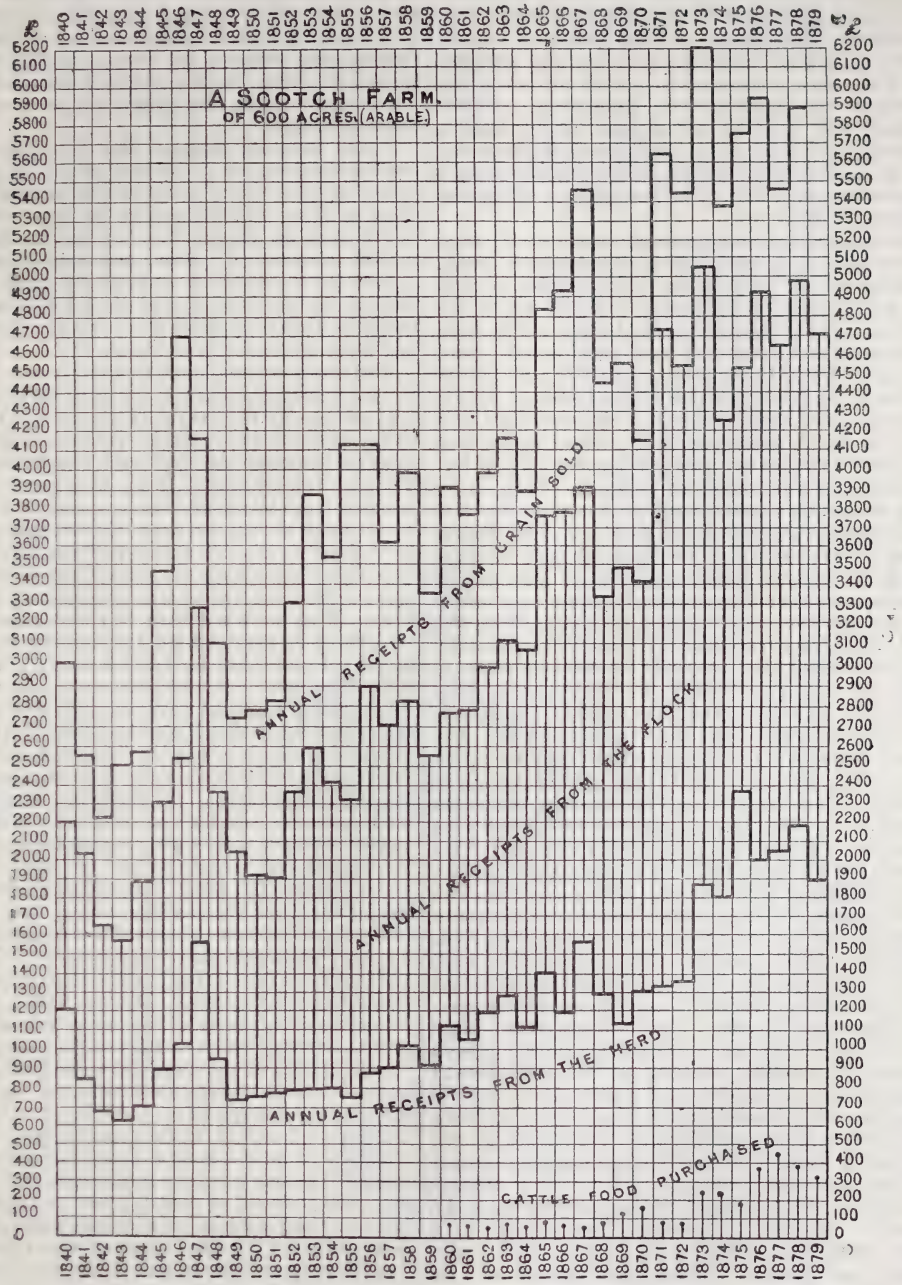


FIG. 5.—FORTY YEARS' RECEIPTS OF 600 ACRES IN SCOTLAND.

dependent obviously on the weather. The period and duration of the harvest weeks are shown in the case of two farms, Clapton, near Hungerford, still occupied by Mr. Thomas Owen, the tenant whose first harvest was got in sixty-one years ago; and Didmarton, on the Gloucestershire Cotswolds. There cannot have been much difference of climate between these two cases, and, as you see, the lines

indicating the length of harvest work—the commencement and the ending—very generally, not, however, always, begin and end very nearly alike. That the harvest was sometimes long and sometimes short—sometimes early, sometimes very late, extending even into December—is seen at a glance. And to this, as well as to the irregular lines below it, indicating the annual average prices of wheat, barley, and oats respectively, I, for the present, only refer, as a picture of the fickle and uncertain character of agricultural experience, which, whether you look to its causes or its results, jumps up and down from year to year without any clue to guide anticipation, and almost without a trace of any sign that it is susceptible of human influence or guidance.

The other diagrams represent more exactly what the variations in agricultural experiences really are from year to year. Take, for example, the case of a Scotch farm of 600 acres arable, of which the total annual produce under the heads, grain sold, cattle sold, and sheep and wool sold, year by year, have been given to me for the last 40 years. These facts may be read hereafter in the tables of figures before me, and meanwhile they are represented in diagram No. 5, where, as in the other cases, you will see that there is a straight horizontal base line on which are built adjacent columns, one for every year, which are crossed by three irregular lines at various intervals, one above another. The height of the lowest of these three lines at each column which it crosses, when read off in the money column, on either side of the diagram, represents the amount of money received each year from the herd, *i.e.*, from the sale of fat or lean cattle. This amounted, for example, it will be seen to £620 in the year 1843, £1,570 in the year 1847, and £2,380 in the year 1875. The length of the interval between this line and the second irregular line across the diagram above it, is still readable as to its money value in the figures at the side, by subtracting the lower figure from the upper, and it represents the quantity of the annual receipt for sheep and wool —from the flock in fact. The upper of these two lines represents, therefore, upon the money column, by its height above the base line of the diagram, the total amount received from the herd and from the flock. Then there is a third line higher still, and the interval between it and the second represents the money received for grain sold each year. The height of this, the highest of the three lines, may thus be taken as representing on the money column the varying amount of the total annual receipts from the farm; and you will see that it jumps up and down in a very remarkable manner. The highest point realised was £6,200, which was realised in 1873; the lowest sum received was only £2,200, and that was in 1842. And though on the whole the lines all rise as the years go by—the receipts, especially from the herd and flock, increasing every year — yet what variety of fortune did not the tenant of this farm experience! In 1841, and 42 and 43 and 44, the total annual receipts varied from £2,250 to £2,480. In 1847, they jumped to £4,900; in 1849, 50, 51, they were again as low as £2,700, and thereafter there was a gradual though still irregular ascent to £5,000, and even £6,000 in the year, with here and there intervals when (in one case for three years together) the receipts were nearly £2,000 less. The short perpendicular lines standing on the base line for the years 1860 to 1879, represent by their heights, read upon the side money columns, the gradually increasing amount of money spent for cattle food. And the fixed, or even diminished, annual amount of receipts for grain sold, indicated by the amount of interval in each column between the second line and the third, shows, I think, that a large proportion of the home-grown grain must also have been consumed upon the farm.

Look, now, at diagram No. 6, which gives an even more complete and better packed representation of annual experience on a farm during the years 1844 to 1878. This describes the practice and experience of the tenant of a Huntingdonshire farm of 332 acres up till 1854, and thereafter of 541 acres; the increase of acreage showing itself, of course, by an abrupt rise in the amount of the receipts under the same three heads—grain, herd, and flock, after the year 1857.

The receipts have here, unfortunately, been differently arranged—the receipts from grain being represented by the height of the lowest of the three lines crossing the annual columns—the shaded interval between the first and the second representing the receipts from the herd; and the receipts from the flock being represented by width of interval above, between the second and third or highest line. The amount of the total receipts is in both diagrams thus read upon the money column by the height of the topmost of the three lines. You will see here too the extraordinary variety of fortunes which the tenant has experienced. From 1845 to 1851 his receipts went down year after year, chiefly owing to the annually diminishing value of grain sold—for you will see that the receipts from land and flock in those four years were nearly constant. In 1851, the total receipts jumped £700, or more than 40s. on an acre over the whole farm. In 1855, the larger area of land was occupied, but thereafter the variations of annual receipts were even greater, rising gradually to £5,200, or nearly £10 an acre over the whole farm in 1863, dropping £1,300 in the next year, and thereafter rising step by step to nearly £7,000 in 1870, and increasing ever since by steps of extraordinary irregularity. The years 1864 and 1865 were bad years so far as the corn crops were concerned. During 1866, 1867, and 1868, the receipts from the herd, you will see by the shortened interval in the columns of those years between the second and third lines, then fell to a minimum, owing, no doubt, to the action of the tenant consequent on the risk of cattle plague. During 1870 and 1871, the receipts from the grain crops and from the flock were extraordinarily high. In 1873, the receipts from both cattle and sheep fell off. The amount of money spent annually on this farm in the purchase of manures and cattle foods is represented by the height of the upright lines in each year, and the height of the slender irregular line crossing these uprights represent the amount paid annually for labour. Altogether it is a surprisingly compact representation of farm experience, and a very striking illustration of the irregularity of farm receipts.

Look now at diagram No. 7, which represents some of the annual experience of a Cotswold farm

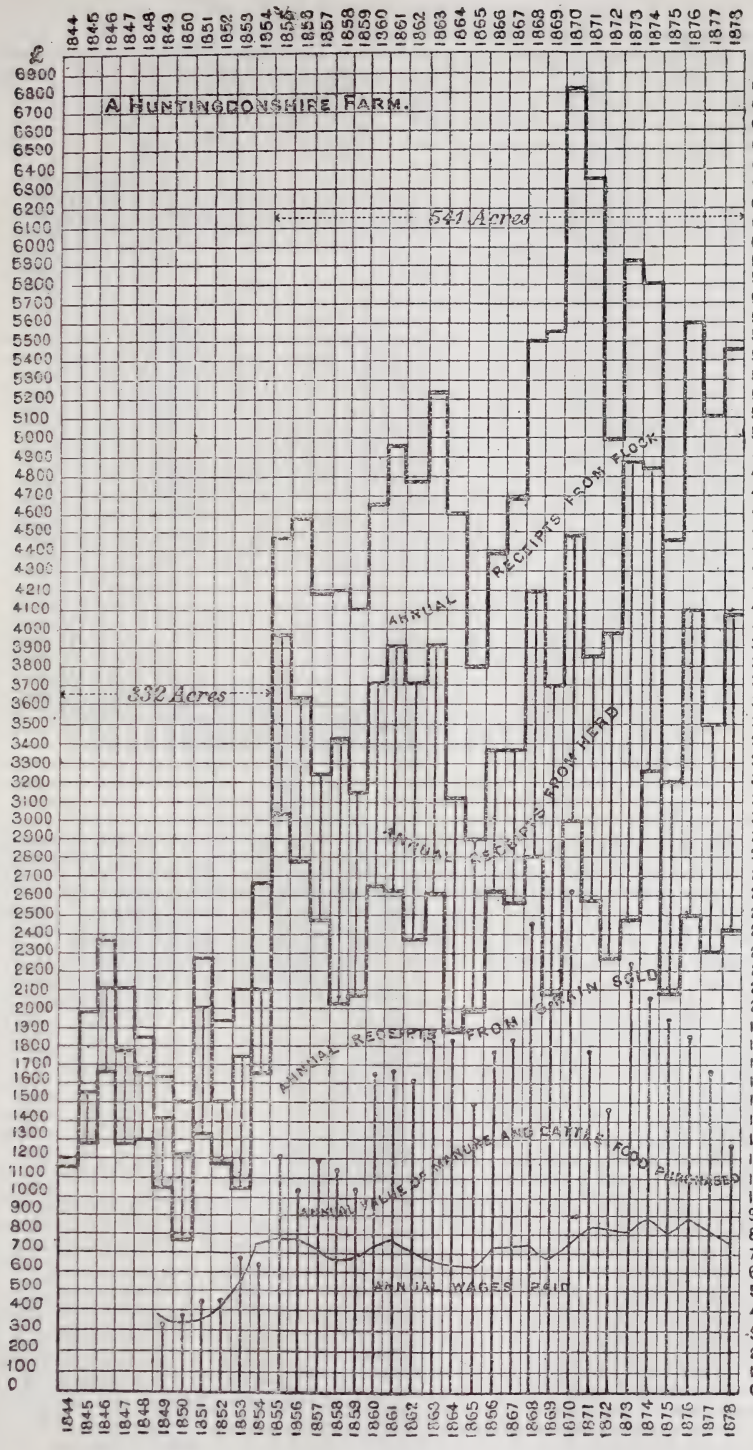


FIG. 6.—THIRTY-FIVE YEARS' ON A FARM IN HUNTINGDONSHIRE.

of 600 acres, of which 200 were old pasture between 1836 and 1866. The line crossing the years in this case represents by its varying height the total annual receipts from grain of all kinds sold, and to this is added in the last few years the amount received for sheep and wool sold. In 1844, only £850, it will be seen, was received for grain sold; in 1846 not less than £2,400 was received; and in 1847 again £850, and not much more during each of the next four years. Then there was a good period culminating in 1854, when £2,100 were received, after which again there was a series of bad years; followed in 1859 and 1860 by two good ones, and then by half a dozen bad ones. The addition in this diagram of the receipts for sheep and wool in the last few years is seen somewhat to modify the general character of the total annual receipts, which, however, as indicated by the ups

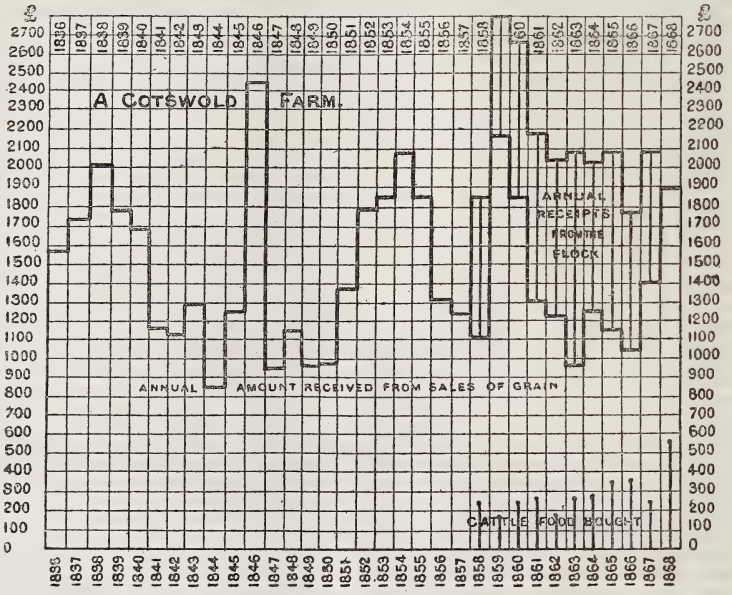


Fig. 7.—Produce of a Cotswold Farm.

and downs of the upper line, was still various enough, and if the receipts from the herd had also been recorded, no doubt the ups and downs of the tenant's annual fortune might have been still further modified. But this diagram, too, illustrates the extraordinary fickle character of agricultural experience.

If now it be said of these pictures of annual receipts that they represent not the variation in the quantity of produce annually grown, but variations only in the quantity annually sold; if, in fact, it be alleged that some of these ups and downs are due, not to the influence of weather on fertility, but to the influence of speculation on the part of the tenant, who has been keeping his grain, for example, past the year of its growth, in hope of a period of better prices—to that I reply that although, in the case of a farm under systematic management and constant tenancy such a thing is extremely unlikely—and, indeed, almost impossible in the case of receipts from a breeding flock and herd from year to year—and these it will be seen are especially variable in these pictures—it may nevertheless be instructive by another diagram to give the case of a large occupation, where that possible source of error altogether disappears. In diagram No. 8, we have the case of a Berkshire farm of 314 acres between 1841 and 1853, and 756 acres between 1853 and 1869, and 369 acres again between 1869 and 1874, when the record ceases. It was under one management during all those years. In this case the height of the lowest line represents the amount of the annual valuation at the end of each year; and the length of interval between it and the upper line repsesents the total amount of annual receipts in each year. Receipts during the year, *plus* valuation at the end of the year, clearly represent the total amount of farm capital *plus* profit—*plus*, I may say, all the three profits to which Lord Beaconsfield lately referred—which the year's proceedings have provided. The total receipts of the year, *plus* the valuation at its termination, is the whole fund to which, if the business then terminates, the farmer looks for his profit and for the return of his capital—on which the landlord, too, draws for his rent, and out of which the labourer has been paid. It is this total sum (receipts *plus* valuation) that is represented here by the height of the uppermost irregular line crossing the annual columns as read off on the side money columns. If less produce had been sold in any year than was produced in that year, the interval between the two cross lines in the diagram would, no doubt, be less than it ought to be, supposing its object to have been to represent the value of the year's growth; but the value in the rick yard, and cattle stalls, and sheep pens, would be so much the greater, and the amount of the valuation at the end of the year would thus be increased. That, again, would be represented by a greater height in the lower of the two cross lines, and so the error to which the interval between the two would give

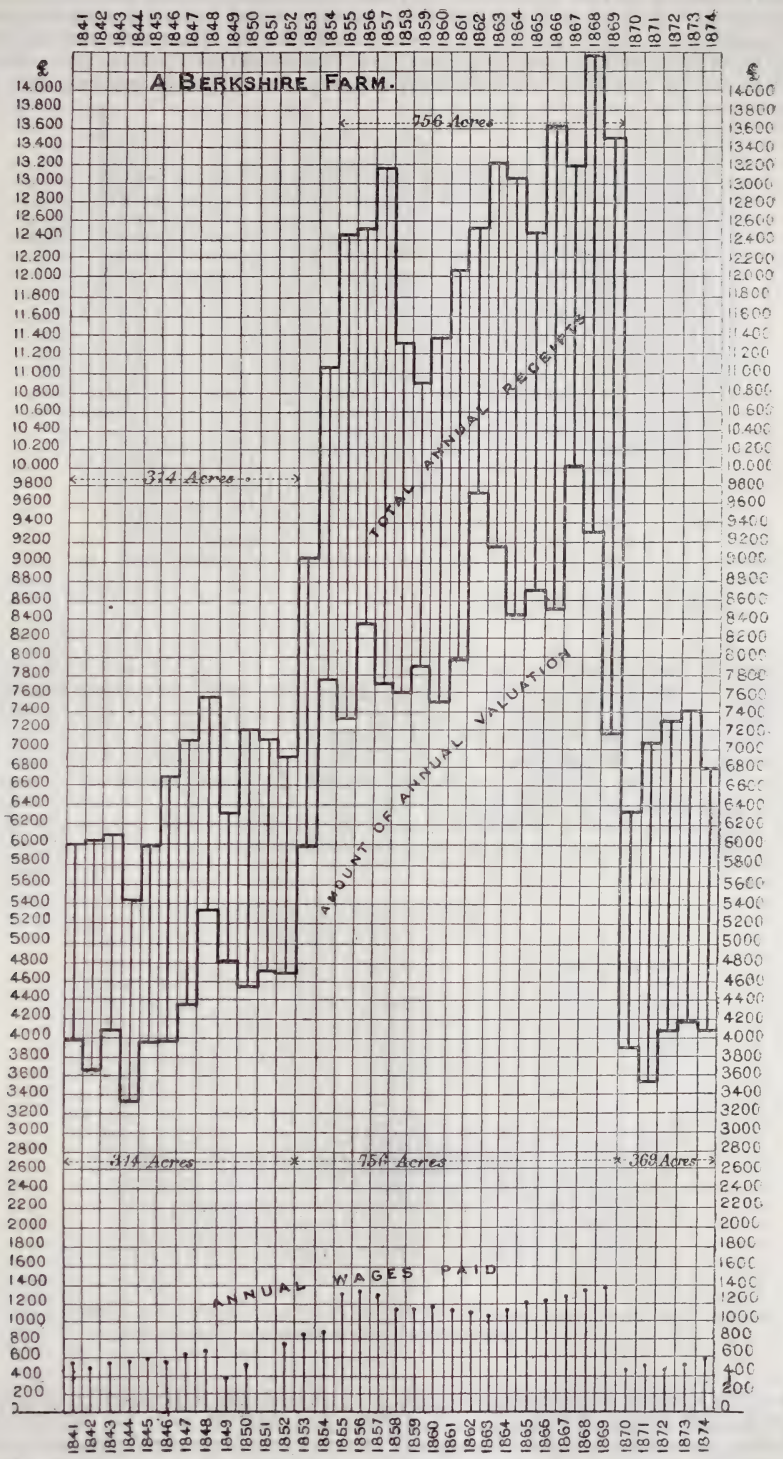


FIG. 8.—THIRTY FOUR YEARS' RECEIPTS AND VALUATION ON A BERKSHIR FARM.

expression would be corrected, and the height of the topmost line remains a correct picture of the year's productiveness. And what a remarkable picture of the variations of farm experience it presents. In 1844, when the tenant occupied 314 acres, the valuation was £3,350 and the receipts £2,050, making £5,400 in all. In the next four years the farm continually yielded more and more, until the year 1848, when the total valuation and receipts reached £7,550. Then came four bad years, which lost the tenant £1,200, or £3 an acre; and his receipts and valuation together reached only £6,350, and

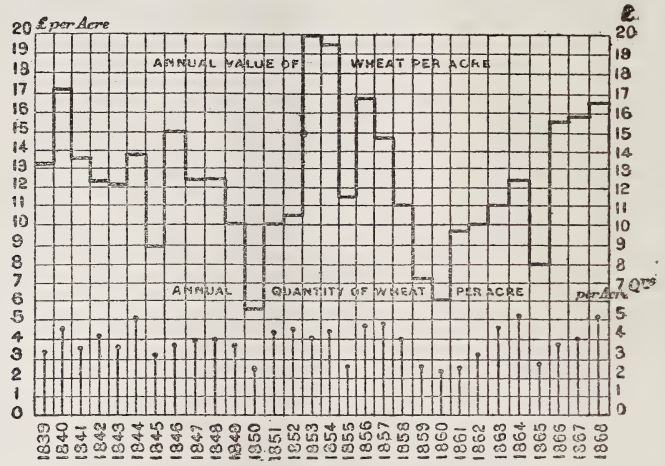


Fig. 9.—Value and Produce of Wheat per Acre on a Fen Farm.

after a few irregular years came the addition to his acreage, when, of course, receipts and valuations together jumped several thousand pounds—more capital being put into the business. In 1854, £11,100 was produced by receipts and valuation, and in the next three years £12,500 to £13,000 were produced; then there came three bad years, during which the farmer, having lost £2,000 in the year 1858, failed to replace his loss for that period till almost the last year of his enlarged occupation, when there was a succession of prosperous years, the receipts and valuations together rising several hundred pounds every year until 1868, when the enormous amount of £14,400 was reached, £4,400 in the form of receipts during the year, and £10,000 the amount of valuation at the close. This valuation was in the following year realised by sales consequent on the reduction of

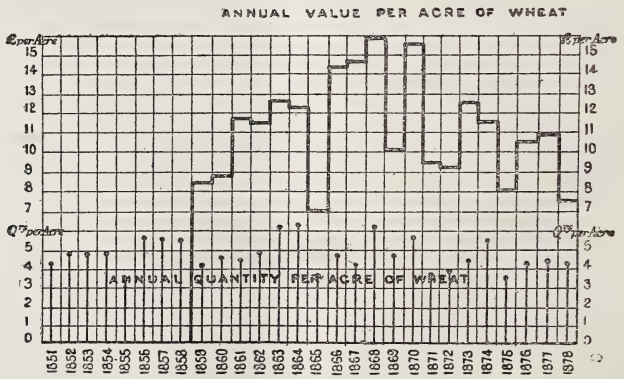


Fig. 10.—Value and Produce per Acre of Wheat on a Farm, reported in the "Times."

the farm; and the amount of receipts and valuations together were, therefore, of course, immensely reduced. In the extremely irregular character of the upper line of this diagram we have accordingly a true and unquestionable picture of the extremely fickle character of farm experiences.

This is shown in an equally unquestionable way by diagrams 9 and 10, which represent the amount actually realised per acre by the sale of the year's wheat crop on two farms. The one is a fen farm well known to me, the other is an anonymous farm described some months ago in the

Times newspaper. What a picture of varying fertility we have here! The wheat crop, which in 1840, on the fen farm, was worth £17 5s. per acre, and in 1853 and 1854, no less than £20 and £19 10s. per acre, was, in 1845, worth only £9 per acre, in 1850, only £5 10s. per acre; in 1860, only £6 per acre. The same picture of surprising variety of experience is shown in the sister diagram; and where they cover the same years, it will be seen that they tell the same story. The bad year of 1860 is, in both cases, followed by four gradually improved years, and then there is a drop in 1865, followed by a succession of good harvests. The tenant of the fen farm told me that he realised

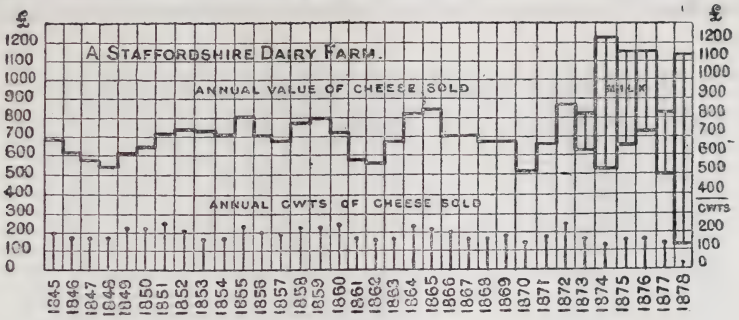


FIG. 11.—ANNUAL PRODUCE OF CHEESE.

only £1,500 by his year's grain crops in 1850, and that he made £5,000 of his year's grain crops in 1853. The quantity also grown per acre is shown by the height of the upright lines in each year, the value realised on the sale being shown by the height of the irregular line crossing the annual columns, and in each case the money value indicated may be read at the side.

And a similar variety is experienced on dairy farms, which are chiefly pasture-land. Of these I have three illustrations, all belonging to Staffordshire. The first is the case of a 300-acre farm, wholly pasture, from which the total quantity of cheese manufactured, and the amount realised in each year—from 1846 to 1879—are represented, the first by the height of the upright line for each year read off as cwts. in the marginal column, and the second by the height of the line crossing the annual columns, which varies, it will be seen, several hundred pounds per annum on a maximum of £840. In the last six years, it will be seen that the quantity and value of cheese manufactured very much fell off. This milk was, in fact, sold direct to the consumer, and the interval between the two cross lines in those years, shows the annual amount of the receipts for the sale of it. In this case the increased height of the top cross line shows the largely-increased amount of receipts from the dairy. Of course, these increased receipts are not to be taken as meaning exactly so much increased profit. They mean only gross receipts; the farmer in this case had to purchase artificial food, and was at greater expense thad usual in other ways, as in the more frequent change of

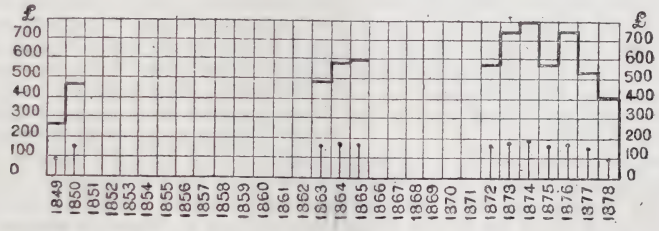


FIG. 12.—MAKE OF CHEESE ON A STAFFORDSHIRE FARM.

cattle, as soon as he went into the milk business. No doubt he found it answer well enough, notwithstanding that here, too, as seen in the year 1877, he occasionally met with great reductions in his receipts. Here, however, also, you can gather that the variations in the total receipts as between 1876 and 1877, and 1864 and 1865, amount to as much as £300 a-year—almost a rent; in 1873 and 1874, indeed, to £400 a year—quite a year's rent.

Take also the fragmentary diagram, No. 12, where the cheese made and sold upon another farm is recorded for the years 1849 and 50, also for 1863-64 and 65, and again in 1872 and 1878, the rent of the annual experience not being accessible. These peeps at the tenant's experience, as of a landscape through rifts in the clouds which hides the most of it from our view, give the same impression of variety and singularity; and we cannot doubt if the whole scene were before us we should see the same extraordinary fickleness which is characteristic of all agricultural experience.

I have still another picture of a Staffordshire dairy farm, where the land is partly arable, and where the receipts from the flock are a consider-

able part of the whole. In diagram No. 13, the top line represents, by its height above the base, the total amount of the valuation at the end of the year. The lowest line indicates the amount received for the cheese sold each year, including also the profit from the pigs fed on the whey, and the interval coloured between the lowest and the second line is the profit (in this case not the total receipts) from the flock. The inner upright lines belong to the years 1867 to 1878, and read from their own base line upon the money column at the side, represents the quantity of cattle food bought each year. On this farm, too, it is plain that there is a very irregular experience.

On diagram 14 the experience on a farm of very changeable area in County Cork has been given to me. I have, however, reduced the figures to their values for a constant area of 500 acres, so that here,

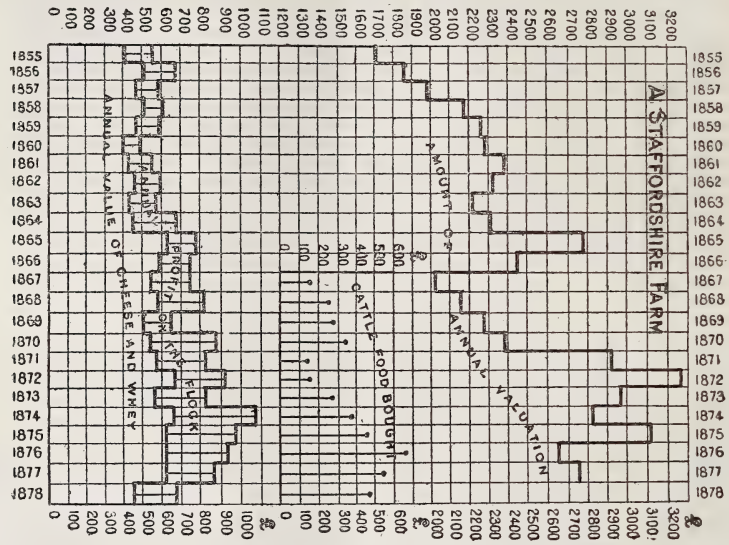


Fig. 13.—Annual Receipts on a Staffordshire Farm.

too, the variations experienced are accurately represented. The top line read off on the marginal columns represents, as in diagram No. 7, the total of receipts during the year, *plus* valuation at the end of the year; and the lower line represents the amount available in each year, after payment of all expenses for landlord's rent and tenant's profit. The uprights on the base line represent the annual quantity of the labour bill, and the uprights on the other base line, midway of the diagram, represent the quantity of money spent each year in the purchase of manure and cattle food.

It is not a very bright picture of the landlord's experience of profit (for it is a home farm that is here described). The balance available for both rent and profit varies from £150, its lowest value when the land was first taken in hand, to an average of about £950 during the last ten years, barely £2 an acre for both rent and profit at a time when the amount of farm capital invested must have been about £6 or £6 10s. per acre. But it is evident from the gradual rise in the produce columns, as time passes, that the estate is improving —the year's produce, though variable here, as elsewhere, is on the whole decidedly increasing, and the balance available for rent and farm profit is also, though more slowly, improving.

These, then, are my pictures of agricultural experience. They are not very many, but they relate to northern, southern, eastern, western, midland counties—to an Irish county also; and they may be taken as fairly representative of the general truth —illustrating the ups and downs, the fickle character of farm experience in a very striking manner. Let me ask—Do you see a straight line anywhere among them, or even a well-conditioned curve? On the contrary, they are, all, uncertain, irregular, zig-zag —I might even say "higgledy-piggledy," "rough and tumble:" and that is agricultural experience. There is no such thing in it as constancy or uniformity. One might almost say, looking at these pictures of it, there is little in them to suggest—hardly anything to justify—a rule of conduct. And the chief lesson, I submit, that is taught by them is the need of leaving such a fickle and uncertain business as far as possibly unfettered by such rules; so that the master, able to use his opportunities, and educated by his experience, shall be the more capable of dealing with his difficulties as they unexpectedly arise. I shall have to refer to some other illustrations of our agricultural experience and of our present agricultural plight, which cannot be easily represented in the diagram, but I may say that I have at length reached the third division of my paper.

3.—The Lessons.

My pictures, it will be seen, relate almost exclusively either to the quantity and the value of the annual produce of the farm under its several principal divisions—grain crop, flock, and herd, cheese and milk—or to the total money produce of

the year and the valuation at the end of the year. In a few cases the expenditure on cattle foods, on manures, and on wages is also exhibited; and it is easy to infer from these diagrams when the tenant has been prosperous and when he has been losing money, for the money produce jumps, sometimes as much as two rents in a single year, and falls again for years together below the possibility of paying away rent at all out of the profits of the year. The main lesson which the diagrams teach—viz., the extreme uncertainty of the year's receipts—is taught by them most effectively. No attempt, however, has been made to exhibit with precision what the profits or the losses of any year have been. To do that it would have been necessary to have made inquiries into the details of all the other costs—constantly growing costs, to which a farm is liable—rent and rates, and wages,

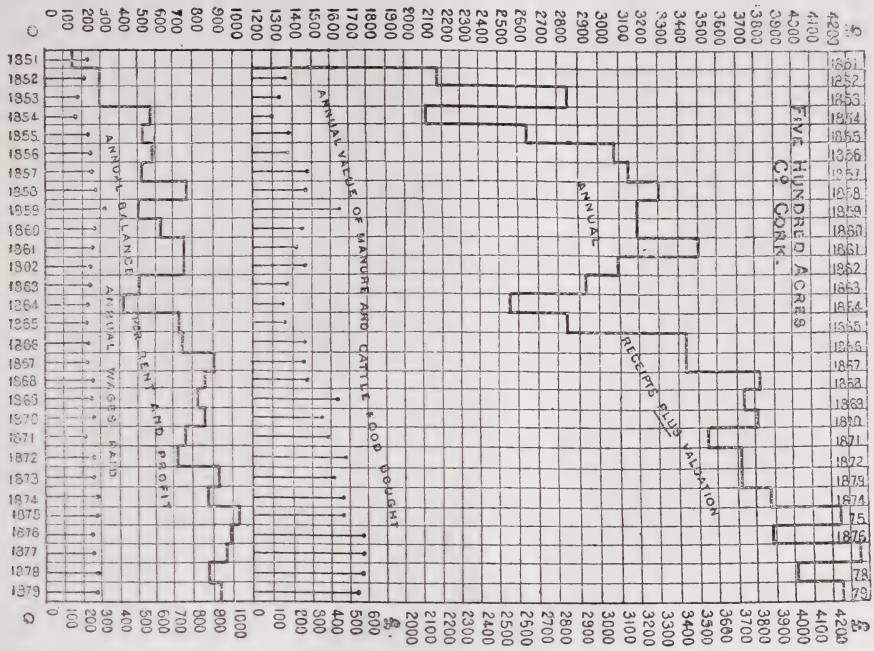


FIG. 14.—ANNUAL EXPERIENCE OF AN IRISH FARM.

tradesmen's bills, and seed, and purchased helps, whether for the cattle stall or the dung-heap. But bold and almost graceless as I have been in asking questions, I could not ask a man to reveal his actual financial condition, even though he might know that he himself would remain absolutely anonymous and unknown. And only in one case has the balance availed for rent or profit been voluntarily revealed. And this was in the case of a home farm occupied by the owner, and shown on the lowest cross line, diagram No. 14, representing an experience on 500 acres in Co. Cork. It is a case of generally growing annual profit, with however several bad years, in which, if £600 or £700 had been deducted for rent of the 500 acres, a considerable loss would have appeared as the result of the year's farming.

It is plain, however, that I might have covered these walls with diagrams, which should have represented, unmistakeably, the growth and constancy of agricultural costs of all kinds, as well as the growth and irregularity of agricultural produce of all kinds; the growth of farm wages, the growth of expenditure on cattle foods and tradesmen's bills. And they would have shown the growth of values also in many particulars. I should have had to represent the growing rents and rates to which land is liable, not only nor always because of intrinsic improvement in the land thus rented or thus rated—but also, and more generally, because of things quite outside the question of intrinsic worth; rents rising because land changes in value, as all other kinds of property are liable to do, simply by variation in the demand for it—increasing, it may be, without a single penny having been spent by its owner in improving its intrinsic worth: rates increasing in amount, with every new charge which the community lays upon itself for purposes thought desirable or deemed necessary by the majority. All these things might have been exhibited, so as to convince anyone of the enormously higher charges which the present farm tenantry of England have to bear, compared with the charges borne by preceding generations.

The main points, however, to which I have wished to direct attention, are those features in the character of agriculture, as a profession, which demand what I consider to be the fundamental and essential qualifications, needed by those who would carry it on successfully.

Incidentally, however, I may point to the indication obvious on the face of these pictures, that agricultural produce in this country is year by year increasing in value. However irregular

these lines may be, they are certainly more or less all rising towards your right hand. This may, perhaps, be due somewhat to growing prices, but the quantities, too, of produce, whether from our cornfields, from our herds, or from our flocks, are increasing year by year. The curve of increasing population no doubt rises even faster and more regularly, and the absolute need, both now and always, of imported food for its supply—proved not only by the uniformity and rapidity of the population increase, but by the irregularity and occasional liability to failure of the home growth—is more than ever obvious as the years go on. But that the home production is rapidly increasing in spite of the discouragement of foreign imports is unquestionable. I say nothing now of increasing costs; but there is at any rate no sign here of the alleged decadence of English agriculture, so far as its produce is concerned. That is one significant and encouraging inference which may be fairly drawn.

Another is the lesson of patience which agricultural experience teaches—not the mere quiescence and contentment which are generally suggested by the word, but the hopeful, resolute, and even obstinate form of it, which one would rather call persistence. How often, looking back through the years represented in these diagrams, has not the English farmer been absolutely ruined! And let it not be forgotten that every period of agricultural depression has been the actual ruin of a great many. They have been disabled by their losses, and have left their farms, and disappeared. To those, however, who have been able to hold on, prosperity has at length returned. Look at the succession of bad years, 1847 to 1850, on the diagram of the Huntingdon farm, No. 6, and see the successive steps upwards again which the produce took in annual value in the years 1865-70. I make no remark now on the ominous increase of expenditure shown in the upright lines belonging to these years—expenditure on manures and cattle foods, and no doubt in other particulars also as the years went on—but I may point to this and to the other diagrams on the wall for ample illustration of the fact that a long period of disaster has been no extraordinary experience in the history of English agriculture, which has nevertheless survived and again attained prosperity.

The main lesson, however, which I desire to offer as, in my opinion, taught by the past of English agriculture, as here depicted, is the paramount necessity of liberty of action for those who follow it as their occupation. Look at the extraordinary irregularity of diagram No. 3, which represents the rainfall of the year, the rainfall of summer months, the rainy days of the two harvest months. That literally is the tune we have to dance to; it is a perfect jig; and it is plain that only those who are unencumbered can keep time to it. Why should we, who have to dance to such a tune as this, be hobbled as if we were animals without reason, bound to keep the road prescribed for us, Here is a business differing from all others in respect to the extraordinary variety of fortune which attends it—differing from all others in these two main particulars—first, that it is prosecuted out of doors, and next, that its chief agency is life, the most delicate and sensitive of all forces. These are at the bottom of the special and characteristic hazards of our life's work. It is easy, or difficult, according to the weather; its produce, much or little, is harvested in safety, or destroyed according to the weather. The living creatures, plants, and animals, which are at once its material, its agents, and its produce, are all subject to every irregularity of that most fickle and uncertain of all external influences—English weather. "There are evils common to all," once said Mr. Disraeli, "but, for the farmer, there are peculiar visitations. A breaking bank, a foolish or perfidious friend, may be the fate of all; but it is not all who have to meet the barren harvest, or the destructive storm, or the three great plagues or furies of rural life—the mildew, the murrain, or the rot." No wonder that, after a succession of inclement seasons, English agriculture should be found in difficulties. No wonder that it should often be in difficulties in such a variable climate as ours. No wonder that after a succession of bad harvests it should be in difficulties now; especially after 1879, the worst of many successive seasons—a year of washy grass and ill-made hay, of poor crops badly harvested, of potato rot, and sheep rot, and foul fallows. Of course, no immediate, perhaps no absolute, remedy is possible; and the miserable expedient, as I will call it, of remitting 20, 30, 50 per cent. of the year's rent may be the best thing which can be done in the meantime. But what is the likeliest mitigation in the long run, what the likeliest source of strength in the future? What should we exclaim with reference to any of our teams if we saw them almost beaten as they struggled up any hill of difficulty. "Give them their heads," we should exclaim; "loosen all those bearing-reins and trammels which hamper and restrain them. Give them their heads, and there will be a chance for them." Have tenant-farmers, as a rule in England, had their heads allowed them? On the contrary, is it not on bit, bridle, and bearing-rein, that the teamster, if I may so designate the legal adviser of the landowner, has for the most part hitherto depended for the safety of the conveyance and the prosperity of the passengers. The farmer as a rule is supposed by the legal agent to be bent on "taking it out of the land;" and his treatment of the land is therefore hedged about with every kind of safeguard, lest the ground be injured by illicit produce. And it needs not that the limit be imposed by lease of any kind, the "custom of the country" will be fence enough—with sufficient rigidity and force in law for the purpose of thus limiting his action.

Of course it is not in any degree as a matter of right or wrong—it is only as a matter of policy or impolicy that I am referring to this question. The owner of the land may let it to anyone with whom he can agree, under whatever restrictions he may choose to impose. He may, if he so pleases, forbid the growth and the sale of potatoes, flax, and even wheat, or any other useful product. He may lay down rigid rules as to the disposal and marketing of the produce. He may forbid the use upon the land of nitrates, lime, or any other dressing which he may choose to designate mere stimulants. He may retain the right to give a twelve months', six months', or even any shorter notice to quit, if so he choose. He may reserve to himself the right to plant trees to any extent in hedgerows, and to feed hares and rabbits to any extent among the

growing crops. All this, of course, is within his competency. No one, I imagine, will dispute it. What rent any tenant so limited can afford to give him for the use of his fields, under such circumstances, and what chance any man thus restricted has of making either a satisfactory use of his capital in farming, or a decent contribution to the food supply of the country, is another thing. And this is the point that I am arguing. At present the farmer is forbidden here, forbidden there, under penalty everywhere. All through his lease he is instructed, limited, directed. And if he be under nothing but the "custom of the country," the limits thus imposed are equally well understood. His annual "work," to use a simile from my own profession, should be every year a new edition, revised and corrected, and in every way improved, and on many a farm it is. In general, however, we must confess that it is almost invariably a stereotyped copy of its predecessor. To tie a man down by rules of cultivation, to make the "custom of the country" his perpetual master, and then set him to contend with seasons, floods, droughts, blights, diseases, and worse than all, with competition in his market with imports sent by cultivators who are unbound and free—this is to leave him without a chance.

There are, however, I fancy, many here ready to exclaim:—"You are giving us a mere fancy sketch—if it was ever true, it certainly is not true at present. You don't seem to know how really free all good tenants are: how willingly permission is everywhere accorded to improving tenants to do what they please in the way of cultivation and of sale; what a mere bogie all these penalties are of which you speak in the case of men who can be trusted." And no doubt lots of instances can be quoted in vindication of this protest. And I could quote as many examples on the other side. I know, for example, that in the summer of 1877, straw was selling in the neighbourhood of Manchester, brought all the way from Belgium, for upwards of £5 a ton. That did not look much like either liberty of sale for English tenantry or common-sense on the part of English landowners. But there is something more significant than mere instances and examples, and that is the whole tone and colouring of opinion prevalent among classes. And the prevalence of the feeling that tenants need restraint by rules and penalties, which shall enfore their doing justice to the land, is unquestionable. Here, for example, is a piece I saw only the other day extracted from the *Solicitors' Journal*. "It is singular," says this journal, "that among the numerous provisions which have been added to farm leases by the ingenuity of conveyancers, so little attention should have been devoted to the obligation of the tenant to keep the land free from weeds. This is, of course, of special importance at the end of a lease, when the temptation to the tenant to neglect this matter is strongest; and no lease for a term of years should be granted without some such provision as that 'the tenant shall have all the crops upon the farm properly cleaned and weeded during the last two years of the tenancy; and the landlord shall have the power to do this work at the expense of the tenant, if it be not effectually done upon notice in writing from the landlord or his agent.'"

Of course it is very desirable that land should be kept clean, but he who thinks to get estates well managed and farming prosperous by inventing new rules and penalties is, I submit, approaching the problem altogether from the wrong side.

He ought rather to advise the landlord, whose agent he may be, that what he should especially desire, and that for which he should strive to equip his estate, whether by improvements or conditions, is a lot of money-making tenants. Let them learn the way to make their fortune off the land if possible, and give them liberty to do it. Land which yields fortune to its tenants is certain to yield rent to its owners.

Of course I know very well that the owner or agent of an estate is perpetually confronted by the case of the incapable and ill-conditioned exceptions among his tenantry; and that, practically, difficulties thus arising have to be met, which no mere confidence in the ultimate influence of liberty and education can, in the meantime, deal with. There are, however, landlords among us who have not been deterred by fear of these inevitable exceptions, from acting on the principle I have indicated. Lord Leicester gives absolute liberty over his large estates. His lease was drawn in 1871, and 34 tenants occupying 23,821 acres hold under it. And he has not, as yet, seen any reason to regret the course he adopted nine years ago. The tenants can grow what they please, in whatever succession of crops they choose—they can sell what they please, and they can virtually treat the land as if it were their own, the landlord retaining the power to require any man to revert to the custom of the country, if it should be seen that he is abusing his liberty, and injuring both himself and the estate.

I have asked Lord Leicester what the experience of the last nine years has been under the new system, and I am allowed to read his reply here. "In no case," he says, "has the liberty I have given been abused, and I have never had occasion to compel a tenant to revert to the four-course system. I complain that the power I have given to my tenants is turned to so little account at present. While scientific knowledge is ignored and dependence is placed only on practical knowledge, it is not very easy to deviate from the beaten track or get out of the ruts used by the last generation. The four-course was well adapted to Norfolk thirty years ago; but strictly to adhere to that system now is ruination." This is a very striking letter, and I say that Lord Leicester has accurately stated the lesson of forty years of agricultural experience, which is, that liberty and education are the two needs of English agriculture—the only true bases of ultimate prosperity. Nor let anyone imagine that because in this latter practical and accustomed knowledge is declared to be insufficient to cope with unusual difficulties, that any such foolish idea is imagined that they can be dispensed with, or that they are not of paramount importance.

Practical knowledge is, of course, essential. It and industry, with sufficient capital, have been the basis hitherto of English agricultural prosperity, and must remain among the most important of its foundation stones for all time coming. And in ordinary times they are sufficient. Let us conclude with pictures of this fact and of that other ominous fact—that in extraordinary times they are insufficient.

In extraordinary and unusual times, certainly

they are insufficient. If it be asked of me, "Why do you desire, by the advocacy of independent liberty and universal education, to upset the present ordinary arrangement—the kindly, almost domestic relationship between the landlord and the tenant—under which, in spite of all your criticism, English agriculture has been the foremost of the world—other nations copying our machinery and practice, seeking our breeds, and looking to us as their leaders"—my reply is, whether we have been hitherto in the van or not, we certainly have been latterly getting more and more into the rear of our own necessities as consumers, and deeper and deeper into the slough of misfortune and distress as producers. There is, moreover, nothing in the liberty which Lord Leicester gives, nothing in the education, freer, more liberal, and more scientific which he desires, which will interfere with those relations, and that pleasant "neighbourhood," which is the charm of country life.

At present the tenant-farmer, speaking of him as a whole class—always a thorough good fellow, always kindly natured, and the very ideal of that mingled independence and submissiveness which is held to befit his position on a great landed estate, is, nevertheless, possessed of hardly any other characteristic. He stands between the great squire and the agricultural labourer, and taking him from youth and age, and from one end of his class to the other, I may say, without, I hope, giving offence, that he partakes of some of the characteristics of both, without possessing, as a rule, any such special class-individuality, if I may use such a word, as we see in other professions, and as undoubtedly we do recognise in some of his number. His strong good sense and homely character gets a colouring from both the sport in which the squire indulges, and from the drudgery which is the labourer's lot. Influenced by the former, which sometimes runs away with him in his youth, and by the latter, which more or less colours the whole life of many of his number, I say that, as a rule, he does not possess that professional characteristic individuality or strength which other professions possess, which they owe to a larger, more liberal, more scientific education. The difficulty of any attempt to speak of this without offence, arises out of the fact that the tenant-farmers whose names we know as speakers at the chambers of agriculture and at the farmers' clubs, and now even as members of Parliament, and who alone will hear or read these criticisms, are the mere exception—they are very few thousands in all (certainly not one in 200 of the class) out of the million or more whom Mr. Caird enumerates—while the immense remainder care for nothing but their work, or, I will add, their sport, never read an agricultural journal, nor imagine that it is worth their while to read or study anything belonging to their occupation.*

I say, then, that notwithstanding the resolution, confidence, ability of the few, it must be conceded that, as a class, the tenant-farmer has not received that education, without which, Lord Leicester says, there is no chance for him in the battle of life upon the farm, invaded as that now is from every portion of the world. Whether a better education would make a better farmer of anyone than we see in instances of men who have unquestionably won success without it, certainly everyone will admit that it will sharpen up the whole nature of the man, and give him an insight, a strength, independence, which without it he cannot generally possess. Certainly the present condition either of tenantry or of estates, cannot be quoted with any satisfaction.

I need not give instances to illustrate this. Pitiable appeals for reduction of rent are an unhappy spectacle, whatever may be thought of the generous abandonment and postponement of the landlord's claim. But it may be protested that these are mere exceptions, and that, as exceptions, they are the proper outcome of exceptional circumstances and seasons. I will quote a case which illustrates the state of things before the last bad years. During the discussion which took place before the enactment of the Agricultural Holdings Bill, a leading land-agent in Lancashire was reported to have said that, in the interest of the landowner, he did not fear the coming Act, which would give both the landlord and the tenant what was due to them, the former receiving for dilapidations, the latter for amendments; for, as he said, had this law been enacted twenty years before, and outgoing tenants had to be dealt with under it now, he could say, from the knowledge of the present condition of estates, that landlords would have more to receive under it than they would have to pay. The estates were, in fact, in worse condition now than they were twenty years before. Surely an unconscious confession of such an outcome of land agency—such an outcome of the ordinary relationship of landlord and tenant as it has been hitherto—must shake the confidence of anyone who protests that no change is necessary, and that when seasons come round again, and trade shall right itself, we shall be all right once more.

Let us, however, heartily acknowledge what admirable success has attended the skill and industry of farmers of what I will call the good old type—although it has failed, no doubt, now under recent pressure.

I went three years ago with others over a well-managed dairy farm of thirty cows in Cheshire, which was competing for the prize offered by the Royal Agricultural Society. We saw the capital herd, the admirably cultivated fields, and the dairy in the perfect little homestead—everything, down to the very flower and herb borders in the garden was neat and clean, and full of profit. And I said to the tenant who was with us, "and now we should like to know something about your expenditure; what about the labour bill to begin with." "Well," he said, "the mistress makes the cheese, and the daughter, a growing girl, is getting able now to help her mother, and we've good sons of our own. About 16s. a week for a single man is all the wages I require to pay." It was a farm of 130 acres—two-thirds pasture. "But your sons are not going to work for board and pocket-money all their days," I said. "Not that, indeed," he replied; "my eldest son I've already put into a farm of his own, and, as far as I can manage it, I hope to find farms for all his brothers in their turn." That is a picture of what we may call the good old style, and an admirable picture it is.

Take now another instance. I was over an

* I was very much struck by the information lately that of the recent volume of reports on English agriculture issued by the English Agricultural Society, only 400 copies have been sold beyond the distribution to subscribers.

arable farm of 1,400 acres in Essex not very long ago for the Enclosure Commissioners, and here too I saw thrift, activity, and careful management—the tenant all alive to the interests of his business and full of energy. I asked of his family. He, too, had four sons. "Some of them still at school, no doubt?" I said; "and no doubt you think that to pay 20s. in the pound, and to educate the bairns, is a very good scheme of life." "Oh!" he roared at me, "I don't hold with it at all. It is easy to over-educate a farmer for his work in life. All my boys come home early from the school and buckle to at plough or drill, with the cattle, or the sheep. I am all for industry and plod." And a capital maxim in agriculture, as in other occupations, is "industry and plod."

Now, in these two instances, we have the very ideal tenantry of a land agency which I will say is safe and successful so long as nothing unusual happens. Here are thoroughly industrious and practical farmers bringing up their families on the same lines wherein they themselves had found prosperity; leaving behind them, let me add, however, in each of these cases, four men seeking farms for one that disappears when the father dies—four men bound to be farmers, for they can be nothing else. This is the great difficulty; men thus brought up have no other resource. In good times they contend with one another, to the undue raising of the rents. In bad times they find the old lines don't answer, but they don't know nothing else, and, bound to stand by the sinking ship, they do but aggravate the danger and the ruin of all on board.

Gentlemen, there are many subjects besides liberty, and the education which would give such men a chance in times of unusual difficulty, which I have not touched upon, any one of which you may have expected would have been named as the true lesson of forty years of agricultural experience. There is the question of tenant-right, compulsory tenant-right, if landowners should be so unwise as not to acknowledge it otherwise—acknowledgement of tenant-right—for the attraction of tenant capital to the land, and protection of it there. There is the question of the landlord's primacy and supremacy as creditor existing in the laws of hypothec and distraint, by which the hitherto excessive competition for land has been aggravated, and the credit of the tenant is made, to the obnoxious injury of his farm, and therefore, of course, to both the landlord and the tenant, to stand lower than otherwise it might. There are questions connected with the game laws, the incidence of local taxation, and other questions connected with the land, belonging to even higher or deeper politics than any of these. And any of them might well have been supposed to contain the chief lesson of past agricultural experience.

I believe, however, that in advocating that which will confer much needed scope, capacity, and power of all kinds upon the tenant farmer, I have hold of a principle which would dominate them all—"Give me security, and I care not for your liberty," and some will say, "Give me liberty, and I can take care of myself," in much more the voice of a man; and it is certain that, with the increased power of a more independent and better educated tenantry, all these questions would find a satisfactory settlement. I ought, of course, to have referred at length to the particular items of that course of training, both practical and scientific, which alone can be considered a good agricultural education, and from which we shall obtain the race of men who will successfully contend with the unusual difficulties which confront us—but time has long since failed us, and I apologise for having kept you beyond the usual hour. And I might have referred at length to what appears to some the most important of all agricultural maxims—the essential oneness of the interests of the landlord and the tenant. This I have left out of consideration altogether. And we may safely leave an allegation of that kind to take care of itself. If this absolute unity of interest exists, it will assert itself, and needs no advocacy. And in so far as it does exist, its influence will not be increased, and cannot be diminished by discussion. It must, however, I think, be plain from the general tone of this paper, that I believe the interests of the landlord hinge far more upon the prosperity of a strong and capable, and therefore prosperous tenantry, than upon any carefulness about the due relations of them to himself. These will grow in the natural way out of the relative positions, powers, characters of the two parties concerned without any, care for them directly, or any special advocacy of them.

No doubt landlord and tenant are one, and except, perhaps, during the last two or three years by some few land agents who have found themselves in unusual difficulties, it has hitherto been believed by everybody that the landlord is that one. The landlord and tenant may be one; but I say, as the most important lesson of 40 years of agricultural experience, that the tenant-farmer is that one. And the sooner that this, with all its spur to activity in many different directions, is realised by all classes whose prosperity depends on his success, the better for them all. On his education—his practical, his scientific, his professional education—on his education for his work and on his liberty in his work—depend all the agricultural profits. My contention, in short, has been that the central and important figure in English agriculture is the tenant-farmer, and that upon his power, his independence, his capacity, depend the interests of landlord, tenant, and labourer alike.

No.	Organic matter and moisture.	Sand.	Alumina and iron.	Lime and alkalies.
1	10·3	71	15·8	1·0
2	9·2	84	5·	1·
3	7·6	62	26·	3·
4	4·4	85	5·	5·
5	5·0	75	18·	2·
6	5·5	88	6·	·5
7	15	55	15·	15·
8	14	75	9·	2·
9	19	65	13·	3·
10	4	88	7·	1·
11	12	75	12·	1·
12	15	55	17·	13·
13	5	89	5·	1·
14	0	23	2·	75
15	8	80	11	1
16	7	86	6	1
17	56	28	13	2

NOTES.—(1) Co. Derry (Sir R. Kane); (2) Midlothian (John) ston, *Journal of Agricultural Society*, vol. xii., pp. 532, 546; (3- Carse soil (Thompson); (4) Loam; (5) Stiff soil; (6) Sandy soil; (7) Calcareous clay; (8) Soil reclaimed from sea (Voelcker), Agricultural Society's *Journal*, vol. xxi.; (9) Sandy soil (Anderson), *H. Soc. Trans.*, No. 88; (10) Sandy soil, Bedfordshire; (11) Clay soil; (12) Gloucestershire; (13) Gloucestershire; (14) Calcareous soil; (15) Clay soil); (16) Sandy soil; (17) Peaty soil from Somersetshire (Voelcker), *Journal* of English Agricultural Society, vol. i., second series.

ANNUAL EXPERIENCE ON ARABLE FARMS.—(See Diagrams No. 7, 6, 5, and 14.)

The Year.	Gloucestershire.		Huntingdonshire.					Scottish farm, 600 acres arable. Annual receipts.			What yield per Acre.		A farm in Co. Cork. Annual experience.							The Year.
	Annual grain receipts.	Annual wool receipts.	Annual receipts.			Annual payments.		Grain.	Cattle.	Sheep and wool.	"Times."	Tring Farm.	Acres.	Amount of receipts plus valuation at end of year.	Rent plus profit.	Receipts plus profit per 500 acres.	Receipts plus profit per 500 acres.	Wages paid per 500 acres.	Manure and food per 500 acres.	
			Grain.	Cattle.	Sheep and wool.	Food and manure.	Wages.													
	£	£	£	£	£	£	£	£	£	£	£ s. d.	£ s. d.		£	£	£	£	£	£	
1836	1,573	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1836
1837	1,714	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1837
1838	2,014	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1838
1839	1,790	...	...	...	...	...	...	...	...	...	13 6 0	...	...	...	...	...	...	...	...	1839
1840	1,686	...	...	...	...	...	...	788	1,214	1,000	17 2 1	...	...	...	...	...	...	...	...	1840
1841	1,150	...	...	...	...	...	...	543	815	1,198	13 8 0	...	...	...	...	...	...	...	...	1841
1842	1,130	...	...	...	...	...	...	562	677	987	12 5 6	...	...	...	...	...	...	...	...	1842
1843	1,296	...	...	...	...	...	...	946	650	900	12 4 9	...	...	...	...	...	...	...	...	1843
1844	863	...	1,147	...	...	...	...	633	697	1,184	13 8 2	...	...	...	...	...	...	...	...	1844
1845	1,263	...	1,295	234	426	...	...	1,160	900	1,291	9 0 0	...	...	...	...	...	...	...	...	1845
1846	2,453	...	1,659	446	274	...	...	2,188	1,016	1,497	15 0 9	...	...	...	...	...	...	...	...	1846
1847	955	...	1,268	496	320	...	...	915	1,577	1,692	12 9 4	...	...	...	...	...	...	...	...	1847
1848	1,139	...	1,290	351	176	...	...	711	969	1,417	12 10 0	...	...	...	...	...	...	...	...	1848
1849	971	...	1,025	384	224	307	383	723	765	1,268	9 19 0	...	...	...	...	...	...	...	...	1849
1850	984	...	765	446	294	390	356	844	733	1,186	5 8 0	...	333	1,090	96	1,640	145	238	73	1850
1851	1,374	...	1,327	682	280	453	353	882	747	1,171	10 0 0	...	412	1,738	246	2,180	300	205	157	1851
1852	1,790	...	1,145	354	420	460	431	872	750	1,677	10 13 10	...	470	1,961	282	2,800	300	191	105	1852
1853	1,838	...	1,057	684	353	683	449	1,294	773	1,779	19 16 10	...	676	2,856	676	2,112	574	157	84	1853
1854	2,893	...	1,630	451	566	656	756	1,135	779	1,625	19 2 3	...	574	3,038	642	2,560	560	211	176	1854
1855	1,870	...	3,029	910	497	1,212	775	1,189	770	1,560	11 7 7	...	546	3,565	673	3,080	585	231	191	1855
1856	1,307	...	2,789	843	902	1,012	788	1,221	868	2,031	16 11 0	...	542	3,405	582	3,140	533	230	295	1856
1857	1,219	...	2,967	767	931	1,197	722	891	883	1,834	19 11 0	...	...	3,595	844	3,300	776	265	280	1857
1858	1,107	752	2,012	1,388	802	1,148	685	1,149	1,054	1,783	11 0 2	...	...	3,464	569	3,200	502	318	418	1858
1859	2,172	622	2,067	1,064	962	1,048	694	815	968	1,663	7 2 4	8 10 0	...	3,483	672	3,200	620	300	230	1859
1860	1,859	800	2,635	1,086	924	1,636	728	1,126	1,123	1,661	6 0 0	8 19 11	...	3,796	822	3,500	758	269	209	1860
1861	1,309	884	2,626	1,280	1,052	1,650	760	997	1,083	1,703	9 15 7	11 16 9	620	3,841	943	3,100	759	247	267	1861
1862	1,227	798	2,329	1,334	1,068	1,631	712	1,016	1,172	1,806	10 0 0	11 15 3	620	3,655	626	2,940	505	247	178	1862
1863	980	1,091	2,594	1,304	1,335	1,884	692	1,044	1,285	1,819	11 16 7	12 9 3	612	3,110	510	2,560	416	225	138	1863
1864	1,243	784	1,898	1,296	1,483	1,808	661	829	1,124	1,940	12 5 0	12 4 1	...	3,488	877	2,850	715	209	192	1864
1865	1,161	1,012	1,990	892	905	1,459	647	1,016	1,411	2,359	8 0 0	7 0 0	...	4,179	900	3,415	735	213	250	1865
1866	1,057	727	2,618	761	996	1,735	715	1,156	1,199	2,556	15 7 0	14 5 6	632	4,362	1,120	3,420	902	208	250	1866
1867	1,402	685	2,532	805	1,271	1,813	729	1,438	1,536	2,354	15 10 11	14 14 10	583	4,443	1,008	3,810	858	259	286	1867
1868	1,908	...	2,809	1,285	1,308	2,456	732	1,087	1,300	2,055	16 13 6	15 18 10	598	4,479	1,022	3,744	834	248	431	1868
1869	...	...	2,052	1,559	1,880	2,035	675	1,069	1,158	2,318	...	10 0 0	615	4,686	1,044	3,810	848	247	348	1869
1870	...	...	2,993	1,471	2,352	2,120	920	770	1,307	2,116	...	15 9 0	660	4,675	1,001	3,540	757	224	399	1870
1871	...	...	2,357	1,269	2,483	1,765	827	990	1,336	3,400	...	9 9 7	670	4,985	935	3,720	712	258	479	1871
1872	...	...	2,228	1,763	1,010	1,453	819	987	1,347	3,177	...	9 3 2	690	5,141	1,276	3,727	925	242	404	1872
1873	...	...	2,468	2,386	1,083	2,281	809	1,072	1,867	3,155	...	12 12 5	690	5,355	1,217	3,872	884	273	442	1873
1874	...	...	3,257	1,563	1,026	2,097	863	1,124	1,809	2,464	...	11 16 6	696	5,902	1,417	4,240	1,017	274	462	1874
1875	...	...	2,047	1,096	1,266	1,927	805	1,147	2,358	3,196	...	8 1 6	737	5,935	1,472	3,890	993	259	581	1875
1876	...	...	2,491	1,612	1,550	1,863	864	912	1,998	2,921	...	10 9 11	...	6,387	1,436	4,332	974	259	589	1876
1877	...	...	2,308	1,190	1,611	1,670	826	832	2,042	2,617	...	10 19 7	...	6,137	1,297	4,024	879	279	589	1877
1878	...	...	2,410	1,635	1,392	1,392	754	870	2,173	2,771	...	7 10 0	...	6,263	1,376	4,240	982	271	555	1878
1879	...	...	...	...	...	...	...	...	1,902	2,797	...	...	...	...	...	...	...	...	...	1879

ANNUAL EXPERIENCE ON STAFFORDSHIRE DAIRY FARMS.

(See Diagrams Nos. 11, 12, 13.)

A.—Farm of 30 acres.			B.—Farm of 530 acres.				C.—Farm of 31 acres.		
Sale of Cheese.							Cheese sold.		
Year.	Weight.	Price.	Valuation at end of year.	Cheese sold, plus profit on whey.	Profit on sheep and wool.	Produce of cake and cattle food.	Weight.	Price.	Year.
	cwt.	£	£	£	£	£	cwt.	£	
1846 ...	201	682	.....	.....	.....	.....	.....	.....	1846
1847 ...	189	620	.....	.....	.....	.....	.....	.....	1847
1848 ...	191	588	.....	.....	.....	.....	.....	.....	1848
1849 ...	189½	537	.....	.....	.....	.....	.....	.....	1849
1850 ...	206	610	.....	.....	.....	.....	.....	.....	1850
1851 ...	216	650	.....	.....	.....	.....	.....	.....	1851
1852 ...	241	726	.....	.....	.....	.....	.....	.....	1852
1853 ...	216½	745	.....	.....	.....	.....	.....	.....	1853
1854 ...	182	740	.....	.....	.....	.....	.....	.....	1854
1855 ...	189½	713	.....	.....	.....	.....	.....	.....	1855
1856 ...	217	812	1,721	434	114	.....	.....	.....	1856
1857 ...	198	717	1,877	515	138	.....	.....	.....	1857
1858 ...	194	685	1,983	487	114	.....	.....	.....	1858
1859 ...	206	784	2,170	508	100	.....	.....	.....	1859
1860 ...	208	800	2,278	461	114	.....	.....	.....	1860
1861 ...	223	726	2,294	402	93	.....	.....	.....	1861
1862 ...	171	583	2,378	430	111	.....	.....	.....	1862
1863 ...	163	563	2,320	449	145	.....	.....	.....	1863
1864 ...	182½	677	2,210	438	162	.....	125	477	1864
1865 ...	215	829	2,309	456	236	.....	140	578	1865
1866 ..	211	853	2,792	621	168	.....	147	592	1866
1867 ...	201	702	2,436	592	189	156	.....	.....	1867
1868 ...	176	702	2,011	555	232	259	.....	.....	1868
1869 ...	176	689	2,161	587	241	265	.....	.....	1869
1870 ...	174	687	2,291	510	135	337	.....	.....	1870
1871 ...	146	575	2,381	530	351	156	.....	.....	1871
1872 ...	182	685	2,927	570	247	174	.....	.....	1872
1873 ...	217	883	3,244	670	271	250	142	578	1873
1874	153½	688	2,948	534	272	315	182	731	1874
	Milk	222							
1875	129	515	2,848	638	424	400	197	798	1875
	Milk	707							
1876	171	617	3,112	607	375	646	153	576	1876
	Milk	538							
1877	176	707	2,652	602	333	619	177	742	1877
	Milk	434							
1878	160	488	2,752	607	263	544	143	467	1878
	Milk	340					Butter	70	
1879	29	100	.....	460	219	460	106	403	1879
	Milk	1,020					Butter	20	

TOTAL RAINFALL OF EACH MONTH OF THE TWENTY YEARS 1859—1878.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total for twelve months.	Five months from May 1.	Three months from May 1.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1859	0·72	1·23	1·33	2·53	2·21	2·90	2·93	2·65	4·01	2·50	2·93	2·24	28·21	14·73	8·04
1860	1·97	1·25	1·87	1·45	3·57	5·47	2·26	4·48	2·92	1·77	2·72	2·51	32·24	18·70	11·20
1861	0·43	1·93	2·43	1·30	1·39	2·13	2·42	0·94	2·15	1·05	4·65	1·45	22·27	9·03	5·94
1862	1·92	0·31	3·69	2·30	3·06	2·43	2·61	2·74	2·19	3·50	1·13	1·71	27·59	13·03	8·10
1863	2·80	0·67	0·85	0·52	1·27	4·86	0·92	1·44	3·49	1·62	1·84	1·31	21·59	11·98	7·05
1864	1·02	0·85	2·62	0·82	1·86	1·28	0·62	1·33	2·55	1·13	2·49	0·36	16·93	7·64	3·76
1865	3·90	2·01	1·12	0·33	3·40	2·21	2·33	4·10	0·55	6·22	1·96	1·35	29·48	12·39	7·94
1866	3·90	3·72	1·69	1·76	2·03	3·98	1·19	2·76	3·89	2·32	1·73	2·63	31·60	13·85	7·20
1867	2·81	1·44	2·48	2·36	2·45	1·22	4·30	2·63	2·23	1·92	0·86	1·59	26·29	12·83	8·97
1868	3·89	1·21	1·28	1·50	1·58	0·78	0·45	2·28	1·74	2·54	1·03	5·12	23·40	6·83	2·41
1869	2·76	2·48	1·97	1·28	3·27	1·03	0·62	1·26	3·56	1·87	2·38	2·94	25·42	9·74	4·82
1870	1·38	1·21	2·31	0·47	0·70	0·83	1·22	2·69	2·00	3·68	1·76	3·07	21·32	5·94	2·05
1871	1·99	1·27	1·19	2·84	0·92	3·49	4·12	0·85	5·28	1·34	0·60	1·13	25·02	14·66	8·53
1872	3·46	0·96	2·66	1·39	3·05	2·55	2·57	2·05	1·64	5·20	3·98	4·35	33·86	11·86	8·17
1873	2·44	1·96	1·46	0·55	1·56	2·24	1·81	2·87	2·46	2·97	1·87	0·48	22·67	10·94	5·61
1874	1·18	0·91	0·39	1·26	1·14	2·05	0·82	1·32	2·62	3·34	2·21	1·58	18·82	7·95	4·01
1875	3·22	1·06	0·69	1·53	1·61	2·40	4·63	1·79	2·86	4·35	3·36	0·94	28·44	13·29	8·64
1876	0·94	1·97	2·96	1·90	0·94	1·27	0·81	1·79	2·86	1·40	3·07	6·25	26·16	7·67	3·02
1877	4·74	1·78	2·38	2·59	1·91	0·42	3·94	2·23	0·82	1·97	3·88	1·51	28·17	9·32	6·27
1878	1·31	1·49	1·12	4·97	3·89	6·71	0·64	6·72	0·83	1·99	2·95	1·46	34·08	18·79	11·24
Mean	2·34	4·49	1·83	1·68	2·09	2·51	2·06	2·45	2·53	2·63	2·37	2·20	26·18	12·77	6·06
Greatest	4·74	3·72	3·69	4·97	3·89	6·71	4·63	6·72	5·28	6·22	4·65	6·25	34·08	18·79	12·39
Least	0·43	0·31	0·39	0·33	0·70	0·42	0·45	0·85	0·55	1·05	0·60	0·36	16·93	6·83	2·05
1879	2·87	3·77	0·91	2·72	3·46	4·76	4·17	5·11	3·67	0·80	0·72	0·86	33·82	21·17	12·39

CHARACTER OF THE HARVEST, AS GIVEN IN EVERY 100 REPORTS EACH YEAR IN THE "AGRICULTURAL GAZETTE" DURING THE LAST THIRTY-THREE YEARS.

Year.	Character of Report.		
	Over average.	Average.	Under average.
1846.....	31	60	9
1847.....	16	68	16
1848.....	4	49	47
1849.....	30	65	5
1850.....	15	45	40
1851.....	15	67	18
1852.....	44	50	6
1853.....	11	12	77
1854.....	30	58	12
1855.....	8	62	30
1856.....	60	33	7
1857.....	55	36	9
1858.....	50	46	4
1859.....	11	64	25
1860.....	1	32	67
1861.....	7	37	56
1862.....	1	17	82
1863.....	68	31	1
1864.....	10	50	40
1865.....	15	46	39
1866.....	12	54	34
1867.....	10	36	54
1868.....	62	32	6
1869.....	10	41	49
1870.....	13	54	33
1871.....	3	43	54
1872.....	11	50	39
1873.....	4	34	62
1874.....	66	31	3
1875.....	6	37	57
1876.....	12	48	40
1877.....	3	25	72
1878.....	12	48	40
1879.....	1	24	75

DURATION OF HARVESTS (SEE DIAGRAM NO. 4.)

	Clapton Farm, Berkshire.		Didmarton, Gloucestershire.	
	Reaping began.	Harvest ended.	Reaping began.	Harvest ended.
1815...	...	...	Aug. 17	Sept. 5
1816...	...	...	Aug. 29	Oct. 21
1817...	...	...	Aug. 18	Oct. 1
1818...	...	...	July 23	Aug. 26
1819...	July 30	Sept. 3	Aug. 2	Aug. 25
1820...	Aug. 3	Sept. 7	Aug. 2	Sept. 5
1821...	Aug. 17	Sept. 29	Aug. 16	Oct. 2
1822...	July 15	Sept. 3	July 16	Sept. 3
1823...	Aug. 14	Sept. 19	Aug. 14	Sept. 20
1824...	Aug. 12	Sept. 29	Aug. 6	Sept. 25
1825...	July 23	Sept. 1	July 25	Aug. 30
1826...	July 15	Aug. 21	July 17	Aug. 17
1827...	July 30	Sept. 3	Aug. 1	Aug. 30
1828...	July 26	Sept. 6	Aug. 2	Sept. 9
1829...	Aug. 3	Sept. 30	Aug. 3	Oct. 9
1830...	Aug. 3	Sept. 27	Aug. 6	Oct. 7
1831...	July 30	Sept. 15	Aug. 1	Aug. 29
1832...	July 30	Sept. 12	July 26	Sept. 12
1833...	July 29	Sept. 3	Aug. 1	Sept. 5
1834...	July 22	Sept. 16	July 25	Sept. 15
1835...	July 27	Sept. 2	July 30	Sept. 2
1836...	Aug. 6	Oct. 15	Aug. 8	Sept. 17
1837...	Aug. 5	Sept. 8	Aug. 5	Sept. 20
1838...	Aug. 11	Sept. 17	Aug. 13	Sept. 17
1839...	Aug. 8	Sept. 18	Aug. 10	Oct. 8
1840...	July 31	Sept. 12	Aug. 3	Sept. 8
1841...	Aug. 17	Sept. 18	Aug. 16	Oct. 21

DURATION OF HARVESTS.—(*Continued*).

	Clapton Farm, Berkshire.		Didmarton, Gloucestershire.	
	Reaping began.	Harvest ended.	Reaping began.	Harvest ended.
1842...	July 30	Sept. 21	Aug. 1	Sept. 14
1843...	Aug. 15	Oct. 13	Aug. 14	Sept. 14
1844...	July 29	Aug. 28	July 29	Dec. 3
1845...	Aug. 21	Aug. 25	Aug. 13	Sept. 24
1846...	July 18	Sept. 22	July 23	Aug. 29
1847...	Aug. 3	Sept. 17	July 30	Aug. 28
1848...	July 31	Sept. 7	July 31	Sept. 12
1849...	Aug. 6	Sept. 12	Aug. 9	Sept. 17
1850...	Aug. 5	Sept. 7	Aug. 8	Sept. 4
1851...	Aug. 5	Sept. 20	Aug. 4	Sept. 8
1852...	Aug. 5	Sept. 12	Aug. 2	Sept. 11
1853...	Aug. 11	Sept. 28	Aug. 12	Sept. 21
1854...	Aug. 8	Sept. 9	Aug. 15	Sept. 12
1855...	Aug. 16	Aug. 28	Aug. 16	Sept. 21
1856...	Aug. 7	Sept. 9	Aug. 8	Sept. 10
1857...	July 27	Aug. 28	July 29	Aug. 27
1858...	July 19	Aug. 27	July 26	Aug. 31
1859...	July 18	Aug. 27	July 25	Aug. 20
1860...	Aug. 27	Nov. 12	Aug. 13	Oct. 3
1861...	Aug. 3	Aug. 31	Aug. 2	Sept. 5
1862...	Aug. 12	Oct. 6	Aug. 11	Oct. 4
1863...	Aug. 1	Sept. 17	Aug. 1	Sept. 15
1864...	July 27	Aug. 24	July 25	Aug. 22
1865...	July 26	Aug. 31	July 25	Aug. 30
1866...	July 30	Oct. 11	July 27	Aug. 27
1867...	Aug. 8	Sept. 16	July 30	Sept. 13
1868...	July 16	Aug. 22	July 13	Aug. 10
1869...	Aug. 2	Sept. 8	...	...
1870...	July 25	Aug. 17	...	...
1871...	Aug. 8	Sept. 13	...	...
1872...	July 31	Sept. 11	...	...
1873...	Aug. 1	Sept. 15	...	...
1874...	July 22	Aug. 24	...	...
1875...	Aug. 2	Sept. 11	...	...
1876...	Aug. 1	Sept. 13	...	...
1877...	Aug. 4	Sept. 22	...	...
1878...	Aug. 2	Sept. 13	...	...
1879...	...	...	...	...
1880...	...	...	...	...

DISCUSSION.

Mr. Mechi said he was only an apron-string farmer, but he had had twenty years' experience of it, and he thought not only the meeting, but the whole kingdom ought to thank Mr. Morton for the clear and comprehensive statement he had put forward. There was only one point omitted, and that was the important practical advice that when they had good seasons, and were making money, they should take care of some of it for the bad years which were sure to come, and not go immediately and hire another farm, and thus increase their losses when they came, and diminish their power of making farms profitable by limiting the capital they could devote to it. After a knowledge of the business, which was the first thing, the next requisite was sufficient capital; he assumed, of course, that that capital should be protected by a proper tenant right, and due freedom of action. There could be no doubt that, as had been pointed out by the Chairman in the Royal Agricultural Society's *Journal*, any definition of what was sufficient capital for farming had not yet been arrived at and accepted. The practical men present would, probably, differ considerably in their ideas of the amount of capital per acre which a farmer ought to have, depending in part on the locality from which they came. In one county, where a low standard prevailed, he had been told that £5 per acre was enough, and some even said that £3 was sufficient; on the other hand, he could go into Norfolk and ask a tenant farmer, holding 1,200 acres of light land under Lord Leicester, who would say not much good could be

done with less than £20 per acre. The farmer said that he bought 350 tons of oil-cake a year, which repaid £4,000; and unless he had that amount of capital, he could not farm profitably. He had now retired, and his son was carrying on the farm. It was obvious that on the amount of stock which was kept must depend the amount of manure which went on the farm, and on the amount of manure must depend the crops of whatever kind. The first question a man should ask himself was whether his capital was sufficient, according to modern principles, to make the rent a matter of small pressure. A rent of £1 per acre on a capital of £5 was 20 per cent., but on a capital of £20 per acre, it was diminished in proportion. Agriculture would still have to undergo many changes, especially as he found that in many places the fields were so small, and encumbered with enormous fences, that it was impossible to use a steam-engine to advantage. Another great point was that manure, being one of the elements of success, should not be wasted by exposure to a rainy season, so that a great part of the farmer's profit might not be carried off in the water-courses. He would not go into the question of sewage farming, but it did seem a monstrous national mistake to be importing the hundreds of millions of pounds of food from abroad because they did not produce enough at home, and sending to Peru to buy birds' dung, at the same time that they were wasting the most important means for restoring the fertility of the soil and enabling it to produce the food which was required.

Mr. Clare Read thought if they employed a capital of £20 per acre on the land, that of itself would be a very fair rent. He quite agreed that sufficient capital was not employed as a rule, but, on the other hand, it seemed to him an exaggeration to say that £20 an acre was employed by any of Lord Leicester's tenants. He knew that estate very well, and it was now nine years since the celebrated lease was given to the tenantry, under which they could sell any produce they liked, and could farm for the first 16 years of the lease in any way they pleased. Only a week ago he was in the company of five or six tenants on that estate, and what did he find was the result of the liberty accorded to them? One man had sold during the year 10 tons of hay, and the others had not sold either hay, straw, or roots of any kind. They could crop the land how they liked, and they almost all stuck to the four-course system. Land agents or landlords, therefore, need not be afraid of giving liberty to tenants; these men farmed as well as any in the kingdom, and they fancied the four-course was the best. In his own case he could do exactly as he pleased, and he generally kept to the old-fashioned course; but when you had a certain description of land you could grow a succession of corn crops without injury to it, and with profit to yourself. He did not quite understand the statement that there had been a general increase of produce throughout the country; he was glad to hear it, and should like to find it so in his own case, but during the last five years he had grown less instead of more, and he feared this had been the case with many others. There had been five very bad years, and although the diagrams might show a general rise towards the right hand, he thought it was more owing to the higher prices than to increased production. Every one knew that the production of meat could be enhanced by the use of artificial food. The advantage of the liberty which was asked for would be immensely increased if they could tell what sort of weather they were going to have, even for the next month, and especially for the next year. If he could tell that, he should not care how much land he farmed. But without this knowledge more liberty only gave you as much chance of growing that which did not suit the season as that which did, and therefore, perhaps, on the whole, those who kept to the old system might not be so very foolish. He had always advocated freedom of cultivation, but it was quite possible to expect too much from it.

Mr. J. Dent Dent desired to thank Mr. Morton, not only for the tone of the present paper, but for the whole tone with which the *Agricultural Gazette* was conducted, so far as the landlords were concerned; for they were always treated there with a fairness which they did not always receive in agricultural discussions. He thought the one point on which they must rely for increased prosperity was the increased produce of their flocks and herds; the diagrams, showing the results of the Scotch and Huntingdon farms, showed that the main increase was from that quarter. The Scotchman seemed to use a great deal of his own grain, and purchase very little artificial food, whilst the Englishman bought considerably of artificial food and manures, and, judging by the diagram, he had been rewarded by a considerable increase in meat and wool. The cost of labour had not varied nearly so much as he should have expected. He calculated that for the first five years the average expenditure on wages was £700, for the last five years but one, about £750, and for the last four years, £800 which was not a very great difference. As far as he could make out, for the first five years the food and manure bill was about £800, and the produce £4,280; whilst in the last four years it was £2,425, with a produce of £5,100, which was not on the whole very disheartening. They had gone through a very severe period, but he did not know whether the years from 1848 to 1852 were not nearly as bad. He was somewhat of an optimist, and thought it was as well to look on the bright side of things. No doubt many farmers had gone to the wall, and he feared some more would have to follow before it was all over; but if they had better weather, which was what they wanted most, things would improve. A practical man told him recently, that those who had survived were making good prices for their stock, sheep, and wool, and a fair price for their grain also, only unfortunately, there was so little of it. Landlords had been found fault with on account of the increase of rents, but when a landlord had four or five farmers after one farm, he was no more to blame for getting a good rent than a farmer was for getting a good price for a bullock if he had four or five butchers after it. Now the landlords found that they had farms on their hands, it would be the farmers' turn, and he had no doubt that many who came in now, when they might expect, on the average, far better seasons, would make a good thing of it. The question was, whether they would make a good use of their opportunities, and take care to keep something in hand, or whether they would go on adding field to field, and taking more land into their hands than they really had power to cultivate. There was no doubt that many landlords and tenants had been exceedingly short of capital, and very ill-able to meet the agricultural crisis. Landlords with heavy charges on their estates had not been able to properly equip their farms, their land being often in pawn to mortgagees, whilst he feared many farmers had their stock in pawn to banks, and, when the pressure came, neither were in a position to meet it. That pressure he believed was passing away; in the commercial world, men of capital had been able to stand, and were now beginning to make profits again; and so he hoped it would be with both landlord and tenant. He did not think that the landlord could do without the tenant, or the tenant without the landlord; to a considerable extent they were co-partners. The landlord ought to properly furnish and equip the farm, and the tenant brought his capital to cultivate it. If the landlord could not do that, the tenant would find it a much heavier charge to work it advantageously. He thought that the tenant's capital should be entirely devoted to stock and crop; and that he should not be called upon to make permanent improvements, buildings, drainage, or anything of that sort. He agreed with Mr. Morton that the principle of returning rent was

a fallacious one. A man should take a farm on an average of seasons, and calculate for bad times as well as good, and not expect a return of rent when a bad year came. At the same time, it was a very pleasant token of sympathy between landlord and tenant to do something of the kind; but speaking from a landlord's point of view, he would rather, if he had the means, in bad times, lay out the money in permanent improvements, than in a return of rent, and he thought it would be more beneficial to the tenant in the end.

Mr. James Howard, M.P., said he believed that one outcome of the present depression would be to raise the value of the tenant-farmer class, not only in the estimation of the landlords, but of the whole community. He had seen a good deal of other countries, and there was no class in any other country which compared with the tenant-farmers of England, either in wealth, intelligence, or knowledge of their calling. Hitherto, unfortunately, the policy and usage of England had tended to repel capital from the cultivation of the soil, but another outcome of the present crisis would be, he hoped, to reverse this policy, and to attract capital to it. He had seldom listened to a paper with which he so thoroughly agreed, and his feeling was that it would be almost a pity to discuss it, lest the effect of Mr. Morton's most forcible concluding remarks might be weakened. The diagrams required a good deal of consideration before they could be properly appreciated, and the true lessons drawn from them. One which showed what could be done by the application of manure and cattle food was exceedingly interesting, but it was impossible off hand to draw any general conclusion from it. He believed no two men had done more for the advancement of agriculture than the Chairman and Mr. Morton, and he was much mistaken if this paper would not also have a powerful influence in the same direction. Another good effect of the present depression had been to draw general attention to the importance of the agriculture of this country. There were thousands of men who were acquainted with the importance of commerce and manufactures, but when you talked to them of agriculture, they seemed utterly ignorant of the vast amount of capital embarked in it, and of the amount which the annual produce of our fields represented. Perhaps another good effect would be to modify, not only the laws, but the usages of the whole country. He was surprised to find that more advantage was not taken in Norfolk of the liberty granted by the Earl of Leicester. In his own county, they suffered from want of the liberty which seemed to be made so little use of. He knew a gentleman, a friend of Mr. Read's, who was not allowed until last year to grow two white crops in succession. He found that one of the most profitable crops he could grow was barley after wheat, yet the greater part of his own county, and of all England, were debarred from so doing. His opinion was that they wanted both liberty and security, for neither would be sufficient without the other. He should like to hear from Mr. Morton what sort of drains they were which had lasted 42 years, for he had found very frequently that, after 25 years, drains became almost useless. The diagrams, as Mr. Morton had said, showed great irregularities, and he could only hope they might draw some encouragement from the fact, seeing that for four or five years there had been such a great depression, and that as history repeated itself, they might expect a corresponding rise to take place.

Mr. Albert Pell, M.P., said if he were to begin life again in farming, he should keep his mind more fixed on diagram No. 1 than on any other, and should bestow his greatest care on the selection of the soil to which he was to apply his capital. He should plead for fair liberty; not that excess of liberty which some gentlemen appeared to desire, but liberty which must be accorded to the tenant according to the knowledge he might possess to make use of it. As they got more knowledge, and acquired a greater insight into the secrets of nature, especially if they were ever able to make reliable forecasts of the weather, it would be obviously necessary to give further liberty. Almost all the land he farmed he held under lease, a very fair lease, which had not been altered since he first took the land. He had to farm according to the most approved course of husbandry during the first sixteen years, and during the last four he was limited as to his procedure; but he never, during the whole time, felt any desire to depart from the restrictions which had been imposed upon him by any reasonable and intelligent manager of land; and when he did, he generally got into difficulty. He was much influenced by what Mr. Lawes wrote respecting cultivating barley after barley; he had tried it, and intended to try it again; but he found that the climate of Naseby was very different from the climate of Harpenden, and that he could not keep his land clean in wet seasons as it might be possible elsewhere. That showed that liberty might be used with advantage in one part of England and not in another. He tried to learn all he could, and applied as much capital as he thought safe, but he would not spend more than he could help. If he could put down £1 and get a return of £2 for it, he would do so, but not if he only got back 6d. He did not find any great increase in the yield, if any, over what it was 20 years ago. There was, no doubt, a good deal of land which was badly farmed 20 years ago, which was now drained and well cultivated, yielded more, but, otherwise, he did not believe in much increase, and he thought diagram 3 supported this view, for the line showing bad yields seemed to have been steadily rising since 1846. At any rate, there was nothing in it to encourage the speculative agriculturist. The greatest improvement seemed to be on the Cheshire farm, where the farmer had turned his attention to the sale of milk, and there he thought was one of the greatest openings for the English farmer. The consumption of this article was most insignificant at present. English people seemed to dread to purchase milk, but he hoped the time would come when it would be as freely drunk here as in America. He thought an attorney was the worst man in the world to draw up farm leases; the shorter they were the better, and the more freedom there was in the first sixteen years the better, but no one could object to a more settled course of agriculture being prescribed for the last four.

Mr. Christopher Cooke was glad to hear the remarks on meteorology. Some years ago there was a meteorological society in London, of which he was secretary, which was supported by some tenant-farmers, but not to a sufficient extent. Mr. Symons, of Camden-square, brought out a monthly publication on the subject, and if any farmers were investigating the subject, they could not do better than send their observations to him.

Mr. William Botly said they must all agree as to the importance of this subject, when they remembered that there were about one million of tenant-farmers, who employed about four millions of labourers; and it was generally considered that with freedom of contract, or of usage, from six to seven hundred million sterling could be profitably employed in agriculture. He was much pleased to see the President of the Royal Agricultural Society present, and believed that the system he had supported some years ago of devoting part of the funds of the society to the establishment of agricultural scholarships had done much good. Mr. Morton had not referred to the improvements from the use of better implements, portable manures, and the study of chemistry, the latter of which had been of immense benefit, and would yet be still more, especially if Mr. Lawes's theory and practice were more generally followed. It was, no doubt, true that farmers were not a reading class, which was a great pity, especially now there was so much literature especially devoted to their instruction

and benefit. In conclusion, he felt sure that agriculture would never occupy its true position until the farmer had the same security for his capital as the merchant, manufacturer, or tradesman.

Mr. R. B. Lawes, as the owner of land in several of the home counties, wished to say a word on the framing of agreements. Although his agents made very abstruse agreements, some of which he never read, he never had occasion to act upon them, and had never, from first to last, restricted any tenant in any mode of agriculture. He believed that his neighbours acted in the same way; and he was, therefore, anxious to know how it was that these restrictions had been so detrimental to farming. Agriculture, like all other occupations, ought to have its grand type; and he hoped that some farmers, like manufacturers, were able, in good times, to amass large fortunes. He believed that what pressed most hardly on the farmer were rates, taxes, and tithes.

The Chairman said he had hoped to hear from Mr. Read and Mr. Pell some of their experience in America, but probably they felt under some restraint in speaking of it before their official report was published. The various views, however, which had been brought out in the discussion, were very valuable, and, on the whole, they could not wonder that farmers had earned the title of grumblers. Looking at the deficiency in the wheat crop for the last ten years—the last being probably the worst year in the present century—they could not be surprised at the agricultural depression. He had made an attempt to estimate the aggregate loss during those ten years, and found it amounted to about one crop and a quarter, which had been lost chiefly to the wheat farmers of England. Scotland and Ireland did not grow much wheat, and, consequently, they had suffered less, though, of course, the western part of Ireland had suffered from the potato famine. Such a heavy loss as that, more than anything else, gave the clue to the depression which had existed throughout the country, and he feared it would be some time before it was got over. He confessed that when he looked to the general deficiency in all Western Europe in the production of wheat, which had so much stimulated the production in America, and the prospect they had of more coming, he thought they would see even lower prices. Thus American competition was the most serious that English farmers had ever yet experienced, and he was by no means inclined to think that they had yet seen the worst of it. Two days ago he received, from Mr. Drummond, of the Legation in Washington, a letter, in which he said that the appearance of the wheat crop in America was equal to what it was last year at this time, with 13 per cent. increased breadth, and the appearance of the crop, on the Pacific slope, in California, had never been better. If then, they had a fine season in Western Europe, and an average crop in England, France and Germany, and this overflowing crop in America, he could not see any result but lower prices than any they had yet experienced. The lesson he should deduce was this, that if anything could be done by legislation to take the shackles from the landowner, and to ensure to the capital of the tenant just security, now was the time to do it. The competition was so great that, unless every possible trammel was removed, they could not stand up against it. The deduction to be drawn was, the need of legislation as soon as possible, to give the landowner freedom to do all he desired with his land, and to give the tenant that security for his capital which he was entitled to. Unless this were done, they might see worse things than they could well imagine. He concluded by proposing a cordial vote of thanks to Mr. Morton.

The vote having been carried by acclamation,

Mr. Morton, in reply, said there was only one point he need refer to, and that was the question whether the produce of the country generally was increasing. Mr. Read said his experience was against that idea, especially as regarded the last four years. Now, diagram No. 4, represented that view very fairly, because it showed that during the last four years the produce had diminished, but as a whole that diagram did give the impression that the produce of that farm during the whole period had increased, and the same probably was true of the whole country. With regard to Mr. Pell's inference from the chart of English harvests, which was certainly unfavourable to the idea that, on the whole, the crops of late years had been equal to those of earlier years, it only needed to suppose that his correspondents had a slightly increasing notion, year by year, of what was meant by an "average crop," and even that diagram would be quite consistent with the impression he had, that on the whole the produce of the country had increased. He had no doubt, himself, that every year the idea of what was an average crop was slightly raised, and that would fully account for the gradual rise in the dark colour on the diagram.

MISCELLANEOUS.

AGRICULTURAL SOCIETY'S REPORT ON SEWAGE FARMS.

The report of the judges (Messrs. Baldwin Latham, Clare Sewell Read, and Thomas H. Thursfield) appointed by the Royal Agricultural Society to adjudicate the prizes in the Sewage Farm Competition in 1879, has been published in the last number of the Society's *Journal* (vol. xvi, part 1). Two prizes, each of the value of one hundred pounds, were offered; one in Class I. for the best managed sewage farm utilising the sewage of not more than twenty thousand people; and another in Class II. for the best managed sewage farm utilising the sewage of more than twenty thousand people. In Class I. the sewage farms of Aldershot, Bedford, Guisborough, and Wrexham were entered, and in Class II. those of Birmingham, Croydon, Doncaster, Reading, and Leamington. In explanation of a table of the accounts of the farms for the year 1878-79, it is said "that there is a very considerable difference, both in the amount of capital engaged upon the several farms, and in the gross returns per acre. In cases where market gardening is in vogue, as at Bedford, Birmingham, Wrexham, and to a small extent at Croydon, the gross returns per acre are the largest. The amount of wages paid per acre on these farms is also the greatest. The gross returns per acre for Leamington appear small, but this is due to its being saddled with a large acreage of grass-land, which by itself would not give any great return per acre. When, however, the gross returns per head of the population contributing to the sewers are considered, then Leamington comes out in a more favourable light; but, here again, the large acreage absolutely increases this amount beyond its true value. It should be remarked that a large area of ordinary agricultural land attached to a sewage farm does not always add to the profit of the undertaking. This will be clearly seen from an examination of the accounts of the Reading Sewage Farm, which has a larger proportion of unirrigated to irrigated land than any other farm which we examined, and yet the undertaking has always been carried on at a loss if a reasonable amount of rent is charged for the land. At Croydon, it is shown that in the year ending March 25, 1879, there was a loss of £14 5s. 1¾d. per acre, the gross returns per acre having only reached £10 1s. 11d., as against a loss of £6 7s. 3¾d. per acre in that year,

which was the largest amount lost in any year up to that period on this farm."

The reporters, in adjudicating the order of merit of the several farms, took into consideration the instructions given to them, viz. :—

1. General management with a view to profit.
2. Productiveness of crops.
3. Goodness and suitability of stock (where there were any).
4. Management of grass-land.
5. State of carriers, gates, fences, roads, and general neatness.
6. Mode of book-keeping followed.

In Class I, for farms utilising the sewage of not more than 20,000 people, they submitted that the sewage farm of the Corporation of Belfast, managed by Mr. J. H. Collett, and that of Wrexham, farmed by Lieut.-Colonel Alfred S. Jones, V.C., were equal in merit, and, therefore, they adjudicated the prize to them jointly.

In Class II., for farms utilising the sewage of 20,000 people, they adjudicated the prize to the Earl of Warwick, for the Leamington Sewage Farm, managed under the direction of Captain Fosbery, the Earl of Warwick's agent, by Mr. Fough, the bailiff. They also strongly advised that a second prize should be given in this class to Mr. R. J. Brundell, in connection with the sewage farm of Doncaster, which they considered "an admirable example of thrifty management, and as showing how sewage can be applied to general farming. They are of opinion that it would be an invidious position, for the sewage farm at Doncaster to be placed in, not to receive a prize, having regard to the fact that its merits considerably exceed those of the prize farms in Class I." In accordance with this recommendation, the Council of the Agricultural Society have given a special prize of £25 to Mr. R. J. Brundell. The judges highly commend the sewage farm of the Birmingham Tame and Rea District Drainage Board, managed by Mr. James Anscombe.

In the conclusion of the report, the sanitary aspect of sewage farming is considered, and a table is given, showing the number of persons either living or working on the farms, the number of children residing on the farms, and the number of deaths which have occurred. From which it appears "that the rate of mortality, on an average of the number of years which these farms have been in operation, does not exceed three per thousand per annum." "This," it is added, "is a very low rate, but, in all probability, it may not be lower than would be found in an equal number of selected lives, taken from an agricultural district. The result of the sanitary inquiry shows that sewage farming is not detrimental to life or health."

It is stated that at the present time about 100 sewage farms are in operation in various parts of the country, and detailed reports, relating to the management of those which entered into the competition, are appended to the report of the judges.

ARTISTS' COLOURS.

A letter from Mr. A. H. Church, the present Professor of Chemistry in the Royal Academy, appeared in the *Times* for April 30, in which he pointed out that "the systematic examination and trial, not only of artists' colours, but of oils, varnishes, gums, and painting grounds, form an important part" of his duties. Mr. Simpson, in his letter, printed in the last number of the *Journal* (p. 522), wrote, by mistake, of Prof. Barff, the previous Professor of Chemistry in the Royal Academy, as if he still held that office. A further letter from Mr. Holman Hunt, in reply to Mr. Church's communication, appeared in the *Times* of May 4.

NOTES OF OBSERVATIONS ON INJURIOUS INSECTS.

Under the above title, Messrs. W. Swan Sonnenschein and Allen have just issued the report of the observers, on this subject, for 1879. To Miss E. Ormerod and her coadjutors in this work great praise is due for the energy displayed in collecting and collating notes from so extended an area of the British Isles. The value of these observations, whether to the farmer, the market-gardener, or indeed to all classes, cannot be over-estimated, inasmuch as it brings prominently to their notice the origin of many scourges to trees and crops, and may be the means of preventing, or at least diminishing, them.

In a few notes by way of introduction to the general subject of the report, Miss Ormerod points out that "the weather characteristics of the observer's year, beginning with November, 1878, have been temperatures below the average, and rainfall above the average, with little sunshine, and the returns show insect attack fully up to the usual amount, and insect presence often exceeding it. The unusual cold of the winter, and the depth to which the frost penetrated the ground, do not appear to have acted prejudicially on larvæ subjected to them, either at the time or in subsequent development, and the only cases in which the weather appears notably to have had effect in ridding us of insect attack, is where the persistent rainfall or the tremendous downpour of summer storms have fairly swept the insects from the plants, or in some cases of leaf-feeders, where the plant growths has (conjecturally) been driven on past the power of the larvæ."

It seems that during the winter, which, as will be remembered, was unusually severe, the frost penetrated the earth to a depth averaging from one foot to fifteen inches, while in Perthshire it is stated to have penetrated twenty or twenty-four inches.

Miss Ormerod points out that the popular idea that grubs are killed by extreme cold is not borne out by facts, for, upon an examination of larvæ and pupæ that had been fully exposed to the influence of frost, it was "found that, in all cases—even when the earth was frozen so hard that the mass had to be broken up with a hammer, and the larvæ and pupæ were perfectly rigid—that, on thawing, they did not appear to be in any way injured." Consequent upon this, rather than diminishing the number of insect pests, a contrary effect was produced, for large numbers were secured from the attacks of birds, being buried under the snow or in the frost-bound ground, besides which the excessive cold caused an almost unprecedented mortality amongst the birds themselves. It is stated that, amongst the lepidoptera, some of the injurious kinds were extremely abundant in various localities, as also the surface caterpillars. Amongst coleoptera, the weevils of various species were very plentiful, as were also the injurious diptera. The crane fly larvæ ravaged various localities, and the carrot fly and celery fly played their part, while the onion fly was particularly hurtful in the Isle of Mull. The injury in many places, caused by the gooseberry-saw fly, and, locally, from other species, as also the appearance of *Cynips kollari*, "like a scourge," at the Glen, Tipperary, and (though wasps and honey bees appear to have been respectively less, both in presence and productive powers, than usual) the great abundance of some species of humble bees in the spring, show that the hymenoptera survived; so that, on the whole, it certainly cannot be said that the cold of the winter under review diminished the amount of insect presence in the summer.

Regarding particular insects which are known to feed upon, or destroy certain plants, a large amount of information gathered from various localities is given. A note on the appearance of an unusual amount of the

silver moth (*Plusia gamma*), says that, "the swarm which appears to have started from the north-west of Africa, and travelled in a north-east direction, was observed at Algiers about April 15th to 20th, it reached Valencia, and was spread over Spain, and was also present in the Balearic isles from April 26th to May 3rd, and crossed the Pyrenees on May 26th and 27th. It next appeared in the south-east of France, Switzerland, and Northern Italy; and on the morning of June 5th, thousands of living specimens were found on the snow at the Hospice of St. Gothard. It was then distributed over Germany and Austria at dates of appearance noted as being from June 7th to 16th. Another column crossed the Mediterranean to Sicily, and spread northwards over Italy in June. The more westerly end of the migratory swarm reached Strasburg from June 3rd to 9th, Paris and its environs were apparently not reached till June 15th. The appearance on our south coast was noticed on June 10th, and the moths were subsequently observable throughout the three kingdoms." It was afterwards seen in enormous quantities in many parts of England, becoming, however, more scarce toward the north. One observer, at Exeter, states that he never saw anything to be compared with its numbers; towards the end of September, the larvæ literally swarmed on every garden plant, defoliating the plants, as well as riddling the leaves.

The foregoing notes will show the nature of this report, which Miss Ormerod concludes with the following remarks:—"Those interested practically in the subject do not need information, but to the outside observer the reflection that 'the crop had to be resown' means that the labourer's wages, cost of use of horses and implements, and cost of seed, were thrown away, besides many incidental expenses, including in some cases a certain amount for rent of land that has made no return, will give some general idea of the loss (or the proportion in which, in lesser attacks, it is to be calculated) per acre. If we look at the notes in this report, there is scarcely one observer who does not record definite loss, and this is hardly as one in a million to the amount which, in the aggregate, makes up what has this year been lost to the country at large."

CORRESPONDENCE.

AIR GAS-MAKING APPARATUS.

I am sorry I did not hear Mr. Hearson's remarks on the sun gas apparatus. I did not intend it to be understood that all air-gas generators were made with fibrous material inside. I know that many besides the "sun" are made without, but I know also that they are practically useless with any spirit except gasoline, and also they are enormously bulky and expensive for their power. The generator which I used at the lecture has a capacity of a shade over 1 cubic foot, and works perfectly with any spirit giving off vapour at 70° Fahrenheit. If charged with gasoline, it would, without one of my ordinary blowers, give supply equal in efficiency to 250 cubic feet of coal-gas per hour, and would supply four or five of my largest blast furnaces at their maximum power. My generator is essentially different in arrangement to any other, and has, for its size and cost, an enormous power. For a cost of 35s. I can supply an apparatus perfect for blast furnace work, which will give a supply of air-gas equal to that obtained from a 1½-inch bore supply-pipe of coal-gas, the apparatus being so small and light that it can be lifted with one finger. Let anyone who has an air-gas apparatus compare this with his own, and the difference will be pretty clear. The apparatus I described is simple, easy to make, thoroughly efficient and safe, and is not covered by any patent, I know no other apparatus combining all these necessary qualifications.

THOS. FLETCHER.

3rd May, 1880.

NOTES ON BOOKS.

Report on Cotton Gins, and on the Cleaning and Quality of Indian Cotton.—By Dr. Forbes Watson. 2 vols. London, 1879.

This report is based upon five series of experiments, which took place at Manchester, Dharwar, and Broach, in the years 1871-2 and 1874-5, and were instituted with the view of ascertaining the relative merits of the various gins now in use for cleaning or ginning the different varieties of cotton grown in India, and especially the American variety acclimatised at Dharwar. The amount of seed cotton cleaned during these trials, both in England and in India, was about 120,000 lbs., which yielded about 40,000 lbs., or 100 bales of clean cotton. Dr. Watson concludes his report with these remarks:—"There is less reason now than appeared some time ago to apprehend a serious diminution of the Indian cotton trade through the increasing competition of American cotton. The Indian cotton is not only finding a new and rapidly increasing market in India itself, but it also has taken a firm hold of the Continental markets, and it is possible that the appreciation of the merits and the extensive use of Indian cotton by the Continental manufacturers may be one of the causes which enable them to compete so successfully as they have done of late with the cotton manufacturers of England, among whom the use of the Indian cotton has declined in a very marked manner. It is also due to this Continental competition for Indian cotton, that its market value has of late approached more nearly to that of the Americans than at any previous period. Finally, the competition of the American cotton is not the only circumstance which regulates the cultivation of cotton in India. Unless the prices should fall much below their present level, cotton will continue to be largely grown in India, as over a large part of the country it enters into the regular rotation of crops, and being at all times readily converted into money, is relied on to produce a large portion of the cash to meet the Government rent and other expenses." The first volume of the Report contains a summary and conclusions, and the second, a detailed description, with records of the trials.

GENERAL NOTES.

Exhibition of Carriage Drawings.—An exhibition of the carriage drawings and paintings of heraldry sent in for prizes offered by the Coachmakers' Company, and in connection with St. Mark's Drawing and Technical Class for Coach Artizans, will be opened at the Carriage Bazaar, Baker-street, on Saturday, the 8th inst, at 10 o'clock, and will continue until Wednesday night, May the 19th. The hours are from noon until 8.30 p.m. each day. The admission is threepence, but workmen and their friends will be admitted free.

Singing in Elementary Schools.—The return of the cost of singing for the year ended 31st August, 1879, amounting to £123,680 10s., shows what classes of schools were most successful in earning the largest grants. First ranks the Wesleyan schools, in which there were none ill-taught, and 835 schools earned £6,034 16s., or an average of about £7 4s. 6d. per school. The 5,203 School Board schools

earned £33,248 6s., or £6 7s. 9½d. per school. The 1,951 British and undenominational schools earned £11,925 12s., or £6 2s. 3d. per school. The 1,235 Roman Catholic schools earned £6,809 14s., or £5 10s. 3d. per school. The 15,477 schools connected with the National Society or Church of England earned £70,662 2s., or £4 11s. 3d. per school.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

MAY 12.—"Utilisation and Properties of Blast Furnace Slag." By CHARLES WOOD.

MAY 19.—"Trade Routes between England, Norway, and Siberia." By Lieut. G. T. TEMPLE.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

MAY 14.—"China and the Chinese: their Early History and Future Prospects." By A. TERRIEN DE LA COUPERIE. Professor ROBERT K. DOUGLAS will preside.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

MAY 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. JAMES SIBREE, Jun., F.R.G.S.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MAY 13.—"The Optical Properties of Crystals, and some of their Practical Applications." By Prof. W. G. ADAMS, F.R.S. WILLIAM SPOTTISWOODE, LL.D., Pres. R.S., will preside.

MAY 20.—"Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

CANTOR LECTURES.

Monday Evenings, at Eight o'clock.

The Third Course, by R. W. EDIS, F.S.A., on "Art Decoration and Furniture."

LECTURE VI.—MAY 10.

General Articles of Domestic Use.—Pottery, crockery, glass, plate, gasfittings, sconces, bronze, brass, and iron work.

Members can admit TWO friends to each of the Ordinary and Sectional Meetings, and ONE friend to each Cantor Lecture. Books of tickets for the purpose were supplied to all the members at the commencement of the Sessions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 10TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Robert W. Edis, "The Decoration and Furniture of Town Houses." (Lecture VI.)
Royal United Service Institution, Whitehall-yard, 8.30 p.m. Sir William Thomson, "Improvements in his Patent Compass."
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. Potts, jun., "Remarks on the Rating of Mines and Quarries."
Royal Geographical, University of London, Burlington-gardens, W, 8.30 p.m. Mr. Everard F. im Thurn, "Journeys in the Interior of British Guiana."
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Prof. Wace, "The Data of Ethics."
Social Science Association and Society for Promoting the Amendment of the Law, 1, Adam-street, Adelphi. Mrs. Garrett-Anderson, M.D., "Educational Pressure."

TUESDAY, MAY 11TH...Metropolitan Scientific Association, 13, Blomfield-street, E.C., 7 p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. R. H. Scott, "Wind and Weather." (Lecture IV.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Major-General H. Y. D. Scott and Mr. Gilbert R. Redgrave, "The Manufacture and Testing of Portland Cement." 2. Mr. Edwin A. Bernays, "Portland Cement Concrete, and some of its Applications." 3. Mr. John Grant, "Portland Cement: its Nature, Tests, and Uses."
Photographic, 5A, Pall-mall East, S.W., 8 p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. C. H. E. Carmichael, "Notes on Pre-historic Discoveries in Central Russia." 2. Mr. W. D. Gooch, "Notes on the Occurrence of Stone Implements of the Surface Period in South Russia." 3. Mr. A. Wylie, "Notes on the Western Regions."
Royal Colonial, St. James's-hall, Regent-street, W., 8 p.m. Mr. W. Thiselton Dyer, "The Botanical Enterprise of the Empire."
Royal Horticultural, South Kensington, S.W., 1 p.m.

WEDNESDAY, MAY 12TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Charles Wood, "Utilisation and Properties of Blast Furnace Slag."
Geological, Burlington-house, W., 8 p.m. 1. Mr. W. J. Sollas, "The Structure and Affinities of the Genus *Protospongia*, Salter." 2. Prof. H. G. Seeley, "Note on *Psephophorus polygonus*, von Meyer, a New Type of Chelonian Reptile allied to the Leathery Turtles." 3. Mr. G. R. Vine, "A Review of the Family Diastoporidæ for the purpose of Classification." 4. Mr. George Jennings Hinde, "Annelid Jaws from the Wenlock and Ludlow Formations of the West of England." 5. Mr. E. T. Newton, "The Occurrence of the Glutton, *Gulo luscus*, Linn., in the 'Forest Bed' of Norfolk."
Microscopical, King's College, W.C., 8 p.m. 1. Mr. Chas. Stewart, "The Histology of *Grantia compressa*." 2. Rev. H. H. Higgins, "The Plasmodia of *Myxomycetes*."
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.
Telegraph Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Dr. C. W. Siemens, "The Use of the Dynamo-Electric Current in Horticulture and in Metallurgy."
British Horological Institute, Northampton-square, E.C., 8 p.m. Mr. W. Chandler Roberts, "Some Applications of the Microphone."

THURSDAY, MAY 13TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Applied Chemistry and Physics Section.) Prof. W. G. Adams, "The Optical Properties of Crystals, and Some of their Practical Applications."
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Dr. Phené, "Travels in Asia Minor."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Light as a Mode of Motion." (Lecture VI.) Theories of Light and Colour.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
National Health Society, 23, Hertford-street, W., 4 p.m. Dr. Samuel Wilks, "Overwork and Underwork."

FRIDAY, MAY 14TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. A. Terrien de la Couperie, "China and the Chinese: their Early History and Future Prospects."
Royal United Service Institution, Whitehall-yard, 3 p.m. Captain Samuel Long, R.N., "The Tactical Aspects of the Utilisation of Ocean Steamers for War Purposes."
Royal Institution, Albemarle-street, 9 p.m. Lord Reay, "Certain Aspects of Social Democracy in Germany."
Astronomical, Burlington-house, W., 8 p.m.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.
New Shakspere, University-college, W., 8 p.m. Mr. F. D. Matthew, "Shakspere's Treatment of Fate and Freewill in his Character."

SATURDAY, MAY 15TH...Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "On the Physiology or Functions of Plant." (Lecture II.)
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "The Dramatists before Shakspere." (Lecture II.)

CORRECTION.—In the last number of the *Journal* (p. 519), Mr. Fletcher's *ingot mould*, intended to dispense with the use of a furnace, is, by mistake, styled *Fletcher's Furnace*.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,434. VOL. XXVIII.

FRIDAY, MAY 14, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

LONDON WATER SUPPLY.

The Council of the Society of Arts, having had under consideration the question of holding a public conference on this subject, appointed a Committee to consider and report thereon. This Committee having met several times, and given full attention to the expediency of the Society holding a Conference on the Supply of Water in the Metropolis at the present time, and having confidence that the supply of the best water to the Metropolis will be fully considered by her Majesty's Government at an early period, reported that they were of opinion that no Conference should now be held, and the Council have accordingly resolved not to summon the Conference as proposed.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The annual Conference will be held on Thursday and Friday, the 10th and 11th June, 1880, the Right Hon. JAMES STANSFELD, M.P., in the chair, assisted by the members of the Executive Committee:—Lord Alfred Churchill (Chairman of Council), F. A. Abel, C.B., F.R.S., Sir Henry Cole, K.C.B., C. N. Cresswell, Col. Sir E. Du Cane, K.C.B., Major-General Fred. Cotton, R.E., C.S.I., Capt. Douglas Galton, C.B., F.R.S., T. W. Keates, Dr. Voelcker, F.R.S.

It has been thought well that, at the Conference for the present year, the following subjects, most of which have been raised at previous Conferences, should now be brought together and discussed, with a view to the Conference recording its opinions thereon.

I.—ADMINISTRATIVE ORGANISATION.

1. COUNTY BOARDS.—The necessity for further legislation with a view to develop and strengthen Local Government administration throughout the kingdom, especially by the constitution of County Boards. [*Vide* Resolution of Conference, May 24th, 1878, *Journal of the Society of Arts*, vol. xxvi., p. 737.]

a. That such County Boards, or combinations of them, should, *inter alia*, be charged with the conservation of rivers, including the prevention of floods, and the storage of water; and be empowered to put the Rivers Pollution Act of 1876 in force upon the complaint of any local sanitary authority, or other person aggrieved, and to charge the cost of the proceedings upon the County Rate, or to sanction proceedings of any sanitary authority, or of any such aggrieved person, for such purpose.

b. That such County Boards shall appoint County Health Superintendents in each county.

2. SANITARY DISTRICTS.—With regard to the local authorities of urban and rural sanitary districts, that they should be constituted the local governing body for all purposes for which their area is fit, thus enlarging and elevating their functions; and by entrusting functions requiring larger areas to groups or combinations of such districts.

3. ELECTION.—Election of members by ballot, instead of by voting-papers.

The holding of all local elections on one and the same day, so as to minimise the trouble and economise the time of the electors.

4. LOCAL GOVERNMENT BOARD INSPECTION.—The advisability of strengthening the administrative organisation of the Local Government Board, whilst diminishing centralisation and correspondence.

a. By mapping out England and Wales into a few large areas. Each area to be under the administration of a staff of inspectors, the whole under the superintendence of a permanent Head of the Department, properly assisted, and relieved of secretarial work.

b. By instituting an Inquiry Department, for the assistance of local authorities wanting information and applying for it, charged with the investigation of scientific processes, the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained.

II.—AMENDMENT OF THE LAW.

1. PUBLIC HEALTH ACT, 1875.

a. Amending section 229, by omitting all the words in the first part of the section down to the words "cost or that," and enacting as follows:—"When a local authority has made default in respect of any provisions of this Act, the Local Government Board shall, after due inquiry, make an order limiting a time for the performance of their duty, &c."

[N.B.—Under this section, as it now stands, the Government can intervene only when complaint by some person aggrieved is formally made, and not upon the report of their own inspectors, however flagrant the dereliction of duty. This amounts in the majority of cases, especially where the interests of the poorer inhabitants are concerned, to a defeat of the intentions of the Legislature altogether.]

b. By conferring powers, and corresponding duties, upon local authorities with regard to the construction of sewers, and connection of house drains therewith, as extensive as those conferred upon the Commissioners of Sewers by the 11 and 12 Vic., c. 112, ss. 37, 38, and 46. [*Vide* Mr. Alcock's

Resolution, May 24th, 1878, *Journal of the Society of Arts*, vol. xvvi., p, 717.]

[N.B.—These compulsory powers will apply to *old* houses as well as *new*, and authorise the local authority to do the entire work of connections from the house to the main sewer at the cost of the owners by authorised contractors, after the same manner as gas and water companies.]

c. By amending section 23, and substituting one hundred *yards* for one hundred *feet*, and empowering the sanitary authority to prevent the continuance in old, and the construction in new, houses, of any drain, sewer, or conduit within the building until an outfall for emptying the same has been provided and constructed to the satisfaction of the authority, other than into any lake, pond, river, canal, or watercourse.

[N.B.—*Vide* "Model Bye-laws," Part i., memorandum; Part iv., s. 88.]

d. By enabling local authorities in rural districts to construct new sewers and water-supply works for the special service of outlying dwellings, and necessary for their healthful occupation, and charging the cost of the same upon the owners or occupiers thereof, payment to be made within a period not exceeding twenty-one years, the intent of such provision being that rates for sanitary purposes in rural districts, including water supply, should, as far as practicable, fall on those only who are benefited by the improvements.

2. POLLUTION OF RIVERS ACT, 1876.—Amendments desirable in the Rivers Pollution Prevention Act, 1876. 29 and 40 Vic., c. 75.

a. By striking out of sections 2 and 3 the word "knowingly," as superfluous and embarrassing.

b. By striking out of sections 3 and 4, the words "solid" and "liquid" respectively, and by substituting, whenever necessary, the word "matter."

III.—SANITARY INSPECTION AND CLASSIFICATION OF DWELLINGS.

Discussion of the following resolution:—

"That it is expedient that the Metropolitan Board of Works within the metropolis, and the County Board within each county, should be empowered by the Legislature to make provision for the inspection and sanitary classification of dwellings, upon application being made by the owners thereof; and to grant certificates of healthworthiness in different categories, for terms of years, according to the perfection of sanitary equipment and fitness for habitation of such dwellings; and to determine the scale of fees to be paid for such inspection during construction and repair, and also upon delivery to the applicant of the certificate of classification awarded to such dwelling."

[N.B.—The conditions and mode of granting these certificates would be analagous to the practice of the department of "Lloyd's" Association in granting certificates of class and seaworthiness to the mercantile marine.]

IV.—FURTHER SUGGESTIONS BY SANITARY AUTHORITIES.

CANTOR LECTURES.

Mr. R. W. Edis, F.S.A., delivered his sixth lecture on "Art Decoration and Furniture," on Monday, the 10th inst., in which he treated of such articles in general use as pottery, crockery, glass, plate, gas-fittings, sconces, bronze, brass, and iron work. Specimens in illustration were lent by Messrs. Doulton and Co., Osler and Co., Minton and Co., and Wedgwood and Co. This concluded the third and last course of Cantor Lectures for the present session. The Lectures will be published in the *Journal* during the summer vacation.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

An Examination for the above purpose will be held at the House of the Society of Arts during the week commencing 7th of June. There is no limit in respect to age, occupation, or position of the candidates. The examination will consist of three divisions, viz., for First and Second-class Certificates, and for Honours. Further particulars may be obtained on application to the Secretary, John-street, Adelphi.

PROTECTION OF SHIPS FROM LOSS BY FIRE AND FROM LOSS BY SINKING.

FOTHERGILL GOLD MEDAL.

At the last meeting of the Council, the following report of the Committee appointed to consider this subject, was received and approved, and, in accordance with the report, the Council awarded the Fothergill Gold Medal to Mr. Donald Currie, M.P., and a Society of Arts Silver Medal to Mr. J. W. Wood:—

In June, 1879, the following letter was addressed by Admiral Ryder to the Council of the Society of Arts:—

"Society of Arts, Adelphi, 3rd June, 1879.

"SIR,—The report of the committee of the Society of Arts on Life-saving at Sea is to be moved for in the House of Commons, and Lord Sandon, President of the Board of Trade, states that it will be granted as an unopposed return. This is a compliment to the report of the committee and to the Society of Arts, as it will thus be made a public document.

"The recommendations made by the committee, if favoured by the Board of Trade, could only be carried out provided public opinion is in their favour. The bias of public opinion can only be ascertained by publicity being given to the report. This could not be better done than by the action of the President of the Board of Trade alluded to above.

"I have reason to believe that the Board of Trade would have no objection to forwarding the recommendations in the report, if only public opinion would support them in doing so.

"This being the position of matters in regard to life-saving at sea, it has been suggested that the Society of Arts might do good service by appointing a committee to consider the two following matters:—

"I. How best to preserve ships from destruction by fire;

"II. How best to preserve ships from destruction by sinking.

"I believe, as in the previous case of life-saving, the labours of the committee would be much simplified, and made much more useful, if the wording of the invitation to inventors and otherwise be very carefully considered

by the committee, as the first step after its appointment, and not that it should be issued previous to or at the same time, as is usually the case.

"I am, Sir, your obedient servant,
"(Signed) ALFRED P. RYDER,
"Admiral."

It so happened that, at the time when the letter was received, the then Council was just going out of office, and Admiral Ryder's name was on the list of proposed members for the new Council. The matter was consequently deferred until after the annual election. On its being brought before the new Council in the following month, a committee was appointed to consider the question, and report to the Council. This committee consisted of the following:—Admiral A. P. Ryder, Admiral Nolloth, Capt. Price, R.N., M.P., Thomas Brassey, M.P., B. Francis Cobb, Lord Alfred Churchill, and Captain Toynbee. To these was afterwards added C. W. Merrifield, F.R.S.

The Committee held several meetings, and resolved that it would be desirable to offer one Gold Medal for the best means of preserving ships from loss by fire and from loss by sinking; a Silver Medal for the best means of protecting ships from fire; and a second Silver Medal for the best means of protecting ships from sinking. This proposal was approved by the Council, and a programme of the conditions on which applications for the medals might be made was approved and issued, the date up to which models or drawings could be received being fixed as the 1st January, 1880. By that date 32 applicants had sent in their claims for the medals. The committee held several meetings for their consideration, and came to the decision that the application by Mr. Donald Currie was certainly the one which deserved most regard.

Mr. Donald Currie's claims, unlike those of most of the competitors, were based, not on any specific invention or appliance to be employed on ship-board, but on the method of construction he had adopted in his well-known ships and steamers, and specially in his mail steam packets, voyaging between London and the Cape. In his letter of application, Mr. Currie submitted for the consideration of the committee the two most recent of his fleet of Cape mail steamers, the *Kinfauns Castle*, and the *Grantully Castle*, each of 3,600 tons. He stated that in no service, even in the Royal Navy, was there more careful regard to safety of life in the perfection of construction in vessels than in the ships above mentioned, combining suitability for their trade, and the largest amount of immunity from danger to life and property. Both vessels named were built on the Clyde; the *Grantully Castle*, by Messrs. Barclay, Curle and Company, and the *Kinfauns Castle*, by Messrs. John Elder and Company. The *Kinfauns Castle* is of steel; the first ocean mail steamer built of that material. The two vessels are of the same dimensions, and of the same horse-power. They were constructed of different materials, and on somewhat different lines, for the purposes of speed experiments. Their peculiar features are thus stated by Mr. Donald Currie:—

"1st. In strength and scantlings they are considerably in excess of Lloyd's requirements for the highest class. They have each three steel or three iron decks; the frames are all carried up to the upper deck; the upper deck is planked with teak, the main deck with pitch pine, the third deck partly with pine. In each vessel there is a fourth iron deck in certain of the compartments covering the water-tanks about four feet high. 2nd. Each water-tank serves the double purpose of regulating the trim of the vessel for speed and seaworthiness after coal is consumed, and of providing for the ship's safety in event of striking rocks or sunken wreck. 3rd. In no other ship is there a more perfect—indeed, I might say so perfect—an arrangement of bulkheads; for, in addition to the ordinary bulkheads required by Lloyd's, and suitable for passenger ships, we have water-tight and fire-proof bulkheads extending from the bottom of the ship to the *upper* deck at the forward and after sides of the engine-room, and in the forward and the after cabin divisions of the ships. By these arrangements, fire or water cannot extend beyond the compartment in danger; and for the case of fire we have pumping arrangements for each hold, so that, as in the case of the *Windsor Castle*, which was on fire in the fore hold, we can fill the hold with water. In the event of collision or striking the ground, the vessel can float, although a compartment be filled with water. 4th. With respect to risk from sinking, the power of pumping in these vessels is very great, as in addition to the ordinary circulating pumps, we have Gwynne's pumping appliances, capable of throwing out 3,500 gallons of water per minute through a height of 35 feet. Amongst other advantages incidental to the use of the pumps, I may include the gain from being able to stop or start instantaneously this pump, independent of the main engines. The quantity of water passing through can be regulated with the greatest nicety, and the condenser kept at an even temperature. The circulating pump can be appplied to empty the bilge and water-ballast while still continuing to pump through the condenser, which is very valuable in case of leakage. A peculiar feature of this pump arrangement is, that the engine is placed high up in the engine-room, so as to be able to work independently of the main engine in the event of the fires being put out, and the ship forced to make use of her pumping arrangements in order to be kept afloat. 5th. If one of these ships should run ashore, the boat and life-buoy arrangements are especially fitted for saving life. 6th. In manœuvering at sea to avoid collision, or in entering ports, to prevent risks such as are common in the Thames, the form of the ship's bow, and the adaptation of steam steering gear, enables us to secure the most rapid manœuvering possible. 7th. The mercantile marine, in event of war, will have an important part to play in national defence, and, with the approval of the Admiralty, these ships are adapted to act as cruisers. The bulkhead arrangements and strength in beams and stringers are sufficient to enable the vessels, without straining, to carry heavy guns; while the equilibrium so desirable between speed and economy has been fully secured. These vessels might run from England to Japan, *via* the Cape of Good Hope, without purchasing a ton of coal, and this at full speed, carrying not only sufficient coals with a good surplus on arrival, but having capacity for a battalion of soldiers, with stores and baggage. 8th. In estimating the equilibrium referred to, the cost in coal is often overlooked, and as this cost implies space occupied and time lost by variation in draft through consumption, your committee can easily estimate how nearly we have been able to approach the purpose aimed at, when I tell you that 40 tons of coal per day would take this vessel on her cruise at about 12 knots an hour fully laden; and in the Cape trade such a vessel as the *Kinfauns Castle* can carry sufficient coal from London for a voyage to the Cape and back again without the neeessity for purchasing abroad, and with capacity for 300 passengers, and about 1,800 tons cargo. 9th. There are details which I need not specify, but I may mention we have been amongst the first to use Sir William Thomson's compasses, also his sounding machine. The steering is by steam, and there are reserve hand-steering apparatus, both amidships and

aft, to provide against a breakdown of the steam gear. 10th. The risk of damage to fire hose is prevented by having pipes along the waterway on the upper deck for the supply of water in event of fire. The look-out and signalling arrangements are specially complete to secure freedom from collision."

Considering Mr. Donald Currie's statement of his own case, the committee were decidedly of opinion that he had shown strong claims to the Gold Medal. Before, however, coming to any conclusion on the matter, they resolved to inspect one of the ships referred to in Mr. Currie's letter, and, accordingly, on the 10th of February, the committee paid a visit to the East India Docks, and made a careful inspection of the *Grantully Castle*.

The *Grantully Castle* is a ship of 3,600 tons; she is 360 feet in length, 43 in breadth, and 32 in depth. Her decks are all of iron, the upper, main, and lower deck beams being plated with iron, $\frac{7}{16}$ths to $\frac{5}{16}$ths of an inch thick. There are fireproof bulkheads, $\frac{1}{4}$ inch thick, at the ends of the engine and boiler casings, between the second and third-class passengers, and between the third-class and the crew. By these bulkheads the ship is divided into seven fire-proof compartments, each capable of being entirely separated from the rest of the vessel. The after orlop deck is of iron, and made perfectly water-tight, with an independent hatch to the main deck, so that the lower after hold and the after orlop hold form two independent water-tight compartments. In each hold, holes are fitted through the main deck for passing a hose through in case of fire, these holes being filled up with iron and wood plugs. The water-ballast tanks form practically a double bottom to the ship for nearly two-thirds of her length. Between the engine-room and the boilers there is a water-tight bulkhead, which, in case of need, can be immediately closed. The donkey-engine for driving the feed pumps can be worked from a separate boiler at a higher level than the ship's boilers, so that in case of the furnaces being flooded, steam could still be supplied to work the pumps, which can be adapted to discharge either on deck or overboard, and to draw from the sea or the bilge. The donkey-engine itself could be readily worked, even though the engine-room were flooded above the level of the pumps. There are two reciprocating pumps, one seven-inch Downton pump, one deck hand bilge pump to each compartment, two feed and two bilge pumps, one hand pump arranged to draw from the sea, the bilge, or the hot-well, and to discharge to the boiler, on deck, and overboard. These can, if necessary, be connected with the main engines. The fresh-water condenser pumps can also be used to pump from the bilge overboard. The special arrangements for fire are very complete. There is an abundant supply of hose, but in addition to this, fixed fire-pipes are attached along the side of the vessel, and connection can be made to these at any point required. There are eight boats, all fitted with patent lowering gear. The arrangements as regards drill, in case of a fire or accident, appear to be of the completest and most efficient character, and the committee are informed that these arrangements, as well as the appliances of Mr. Currie's ships themselves, have been fully tested by accidents which have happened to the *Windsor Castle*, and to others of his fleet of steam packets. When the *Windsor Castle* was on fire in the fore hold, that part of the ship was isolated from the rest, and filled with water. In this condition the ship was enabled to return to London.

Besides having examined the vessel itself, the committee made a careful inspection of the drawings of the ship, which, with the specification, were submitted for the purpose by Mr. Currie, and finally they arrived at the conclusion that Mr. Currie's ships showed a marked advance in the direction of preventing loss of life at sea by fire or wreck, and that the attempts which he had made, and the success he had secured in practical arrangements, fully deserved to be recognised by the award of the Society of Arts Gold Medal. In making this recommendation the committee bore in mind that they had not formally before them the ships of other companies than those of Messrs. Donald Currie and Co., many of which, they are aware, are of great excellence and of high merit. None, however, of these competed for the medal, and they consequently did not feel it their duty to institute a comparison between them and Mr. Currie's ships.

Having thus decided on their recommendation as to the award of the Gold Medal, the committee considered whether any of the applications before them deserved recognition by the award of a Silver Medal. As regards methods of protecting ships from fire, the committee do not consider that their merit, in the case of well known inventions, or their novelty in the case of those which were fresh and untried, was such as to require any award. In respect of inventions for protecting ships from loss by accident, they decided to recommend for the award of a Silver Medal the very ingenious leak-stopper of Mr. J. W. Wood, which has on numerous occasions proved of great value, and is coming into extensive use, especially in the merchant service. Its principle is tolerably well known. It consists of an iron toggle, by means of which a plate of iron, varying in size from a few inches to some three feet, can be bolted over a hole in the side of a ship. This toggle consists of a pair of iron bars hinged together. One of these bars is slotted out for about half its length, and the other bar is jointed thereto in such a manner that it can rest within the slot for part of its length, both bars being then in the same line, so that the whole of the slotted bar, and part of the other, can be thrust through the hole in the ship's side. As soon as the slotted bar is free of the hole, it overbalances, and its heavier end swings down, thus forming a T, the cross bar of which is outside the side of the vessel, while the stem passes through the hole. This stem is screwed, and has nuts on it, by which the plate is held fast. A pad of felt is placed between the plate and the side of the vessel, so that when the whole is screwed up, the felt fits over any jagged edges of the hole, and causes the plate to fit more or less water-tight against the side. The committee have had before them evidence of the practical value of the invention, and of its having actually proved of service in many cases of accident.

Another remarkable invention which was brought before the committee was that of the Luminous

Paint, invented by the late Dr. Balmain, and submitted by the agents for the patent, Messrs. Ihlee and Horne. This material possesses the remarkable property of being excited by exposure to light, and of giving out the light when afterwards carried into any dark place. If a board, some two feet square, be covered with the paint, and exposed to ordinary diffused daylight, it will, when taken into the hold of a ship, or any dark place, give sufficient light to enable objects to be distinguished. For use in magazines in ships, or on shore, in spirit rooms, and other places where there would be danger in the use of a naked light, it is probable that this remarkable substance may become of great value. The light given by it, however, is of a very feeble character, and it is only where very little light is needed, and where actual danger could arise from the employment of ordinary light, that it can be of great value. Another suggested use for this paint is the coating of life-buoys, so that they might become visible to a person who fell overboard on a dark night. A full description of the material, and an account of many of its applications, will be found in a paper read before the Society of Arts, on the 11th March last, by Professor Heaton, and published in the *Journal* of the Society for the 26th March. The committee will be glad to learn that the test of experience proves the value of the luminous paint; but they do not think that its utility on shipboard is likely to become sufficiently extensive to warrant their recognising its merits otherwise than by mentioning it.

The Committee have, therefore, to recommend to the Council that the Fothergill Gold Medal of the Society be awarded to Mr. Donald Currie, M.P., for the improvement he has introduced into his Passenger Steamers, having for their object the prevention of loss of life at sea from fire or accident; and exemplified in the ship *Grantully Castle*, of the Castle Line of Packets. They further recommend, that a Society of Arts Silver Medal be awarded to Mr. J. W. Wood, for his Leak-stopper.

By order of the Committee,

H. TRUEMAN WOOD,
Secretary.

ADDITIONAL LECTURES.

FLEUSS' DIVING APPARATUS.

By B. W. Richardson, M.D., F.R.S.

DELIVERED MAY 6TH, 1880.

Those of you who would like to study the history of diving, and the attempts that have been made by men of science at various times to live under water, and to live in factitious gases, will study the following books with profit:—Lord Bacon's "Novum Organum," "The Philosophical Transactions," from the time of Halley, about 1678, onwards; "The History of Inventions," by Beckmann; Smith's excellent "Panorama of Science," 1824; the Hon. Robert Boyle's "Experimental Philosophy;" "Chambers's Encyclopœdia"—the large Encyclopœdia which was the text-book of the last century; "The Encyclopœdia Britannica;" Siebe and Gorman's book on "Diving;" and an essay by Mr. J. W. Heinke in vol. xv. of the "Proceedings of the Institute of Civil Engineers." In these will be found subject matter worth studying; and they, in fact, as far as I can make out, give a fair history of the origin of those discoveries which have led up to the present day. I must give you, on this occasion, the briefest possible description of the course of discovery, dealing not with diving bells, so much as with the fact of a man being able to live under water by himself, not in combination with others, nor in a bell, but in an apparatus connected with his own body.

We go back to the year 1538, to get the first glimpse of an attempt at the process. Schott, in the "Technica Curiosa," published in Nuremberg, 1764, says that Taisnier, a writer he quotes, saw in Spain, in 1548, two Greeks, who, before the Emperor Charles V., went under water in a weighted kettle. They could carry a candle inside this kettle, and so they descended into the water, where they could live for a considerable time. Such excitement is said to have been produced by this experiment, that 10,000 persons, on one occasion, witnessed it in the presence of the Emperor. Schott calls this the aquatic kettle, but speaks of another apparatus called the aquatic armour. Lord Bacon tells us that, in his time, there were means of diving in a similar manner, and he describes the mode in which it was done—a very primitive method, indeed. A tripod was fixed to a bell, and the bell was let down into the water. The tripod was weighted to keep it down, and when the man got to the bottom, he could come out of the chamber—holding his breath—pick up what he wanted, and then go back into the chamber and breathe again.

The Hon. Robert Boyle gives us a very singular narrative in one of his philosophical works. He tells that Cornelius Van Drebbel, a Dutch physician, a man of considerable mark, who has the credit of first constructing a thermometer, made, in the reign of James I., a submarine boat, in which a man could be submerged, and that actually the boat could be rowed by men that were inside it, beneath the water. The air, it is said, was kept pure, or re-supplied by a fluid, carried by the men in the boat, which gave off something equivalent to the air, so that the men got fresh air from a liquid. The statement seems quite incredible, because in that day we cannot conceive any such thing as a fluid which would yield oxygen gas. In this day we have a fluid which is very rich in oxygen gas, the peroxide of oxygen, and when that is put into contact with substances which will set it free, we get oxygen in abundance. But this fluid was not discovered till 1818, when it was first made by the illustrious Thénard, the French chemist. However, a fluid of this kind would precisely answer the purpose described by Boyle. I could make an apparatus in which the oxygen would be supplied from a fluid in that way, but it would be very expensive. The peroxide is now used for a very different purpose; it is the fluid with which ladies stain their hair to a golden hue—the aureoline dye.

In the year 1678, we get a great improvement in the methods of diving, from the illustrious philosopher and astronomer, Halley. Halley reinvented the diving-bell, but he went beyond that; he sent men with helmets on their heads

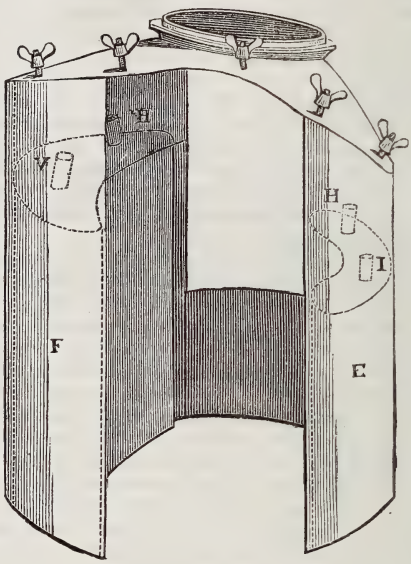
out of the bell with tubes connected with the bell, so that they could breathe from the interior of the bell at a considerable distance from it. In 1776, Charles Spalding improved greatly on this method. He made a helmet and cuirass, and enabled men to decend into the water with great facility. I should say, as a matter of peculiar interest in this room, that Spalding received a "bounty" of twenty guineas from this Society for improvements in diving, and in the descent of men under water. Triewald, a Swede, first introduced lenses into the apparatus—before that time, flattened glass had been used. In 1748, Smeaton began to use a pump much after the manner of the present plans, which allowed the air to pass into the bell through a tube. Mr. Martin, in his "Philosophia Britannica," reports that a gentleman in Devonshire made a very ingenious diving dress, so constructed that it would hold half-a-hogshead of atmospheric air, in which a man could live under water a considerable number of hours. That may be an exaggeration; but the man could live a considerable time, and the inventor made a large sum of money by his invention. In 1798, Klingert invented tin-plate armour, in addition to a leather jacket, and with that two pipes attached, one for inhaling and the other for letting out the air. This continued in use till 1829, when Mr. Siebe, whose firm is still, I believe, continued under the name of Siebe and Gorman, invented a diving-dress, which consisted of a helmet and jacket which came half-way down the body, and of trousers which passed up under the arms. The helmet was supplied with air from above by a pump. When the man was in the water, the exhaled air passed underneath the jacket, and so into the water. That was called the open diving dress. It was very popular, and was not displaced even by another invention of Mr. Siebe himself without some objection by the old divers. Mr. Siebe afterwards invented what is called the closed diving dress. That is a helmet like this, with a cuirass and apparatus for injecting and extracting air.

We have no great advance or change in the method of diving dress until 1854, and then a Frenchman, named St. Simon Sicard, commenced to use compressed oxygen. My friend Captain Galton to-day told me that he was conversant with a method in which a bell was used with compressed air or oxygen in 1844. But, keeping simply to the dress worn by divers under water, we come to 1854 before we get to St. Simon Sicard, who made a dress much after the manner of an ordinary diving dress, but he carried down with that oxygen gas compressed under six atmospheres. He also carried an apparatus by which he could remove the carbonic acid—so that he lived in an atmosphere of oxygen mixed with return air of oxygen and nitrogen from his lungs. He was not, I have been told, so successful in removing the water from the breath, and, therefore, the apparatus was imperfect. Those who used it were subjected to risk, and, for that reason, possibly, it was never brought into practice after the time of which I speak, and then only at various exhibitions. I am not aware that any deep diving was performed in Sicard's dress.

We now come to the dress I am going to bring before you to-day, which was invented by Mr. Fleuss, who is here, and who will show you all the details connected with it. He tells me, and I entirely believe what he says, that his invention was worked out step by step experimentally, and without reference to any previous invention. And as he has succeeded in removing the water of the breath, we may say that this dress is extremely complete.

In the first place then, Mr. Fleuss has a helmet, and within that a chamber which is strong enough, he says, to bear a pressure of 16 atmospheres if he likes to put on so much pressure. The space is one-fourth of a cubic foot in size, and, under pressure, he can introduce sufficient oxygen in the compressed form to last him for breathing purposes for five hours. He does not usually do that in his ordinary experiments; he introduces as much as will enable him to breathe, say for two or three hours. Before putting on this helmet, he puts on a cuirass (Fig. 1*), and in which there

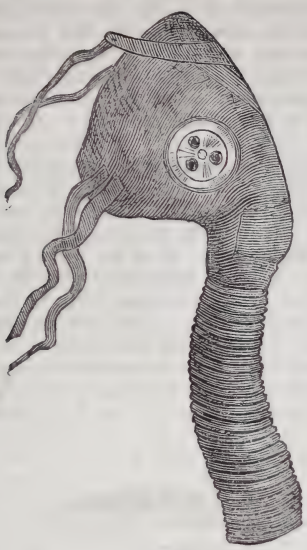
Fig. 1.



are two metal chambers, one in front and one at the back. These metal chambers are fitted with small particles of porous india-rubber, which is so saturated with a solution of soda, that it will absorb very rapidly the carbonic acid gas. After the cuirass is put on, and the dress which covers it, so as to shut off all water, he puts on an ori-nasal mask (Fig. 2), which is very ingeniously constructed, and adapts itself extremely well. It is a mouth-piece partly—not altogether—original. In the early days of anæsthesia, when we were beginning to use ether and chloroform, the late Dr. Sibson invented an ori-nasal mask for that purpose, which is nearly the same, and which fits very correctly. In administering the chloroform, the vapour was inhaled from one aperture, and the breath passed out through another, as you see here. I made, afterwards, a mask very similar, which has been used a great many times, which differs only in that a valve, made of india-rubber, is placed above

* This block, and the one on page 559, have been kindly lent by the Editor of the *Graphic*.

Fig. 2.



instead of at the side. Mr. Fleuss's mouth-piece is made of leather. It fits very tightly to his face, and has two valves, one on each side. These valves open inwards, so that in inspiration he draws the air inwards, and in expiration he breathes through this ingenious artificial wind-pipe. It is a very good imitation of a wind-pipe on a large scale, and he was very prudent in making it large enough, for we found originally we were much impeded by making too small a tube. Mr. Fleuss also found that in breathing there should be a large tube, and he has made it large accordingly. The mask is placed over his mouth and nose, and is tied firmly by a band which goes to the back of the neck. Its exit tube passes into one of these chambers containing soda within the cuirass. When he exhales, his breath passes down this tube into the first chamber, and over the soda, then through another tube within the cuirass, and through the second chamber, again over soda, finally it escapes at an opening near the shoulder into the helmet. In the process of breathing through these tubes, all the carbonic acid gas of the breath—all that is poisonous—has been removed, reserving something else. In breathing, we take in a certain quantity of oxygen with each breath, but we do not use the whole of it. There is a measure of *reserve* oxygen left enough to sustain life for two or three minutes, if, from any accident, we are removed from the air. There is *return* oxygen—oxygen which has not been used in the lungs, and which goes back into the helmet, and is used again for breathing. In addition to that, there is the nitrogen which dilutes the oxygen in the ordinary atmosphere to the extent of four parts of nitrogen to one of oxygen, and that nitrogen, a negative substance, diluting the oxygen, all passes through these chambers and comes into the helmet. Mr. Fleuss has a tap in the helmet by which he can, when the helmet is adjusted on to the cuirass, admit oxygen freely, so that it can commingle with the nitrogen and the return oxygen. In this way, within the helmet, he is always making a new atmosphere for himself, and that is the principle of the invention. One other improvement he has made, which is a very important addition to previous attempts of a similar kind. He has a little space at the lower part of the soda-chambers to receive the water that passes by the breath and is condensed. There is a perforated or false bottom below, and a trough into which the water of the breath falls, and so he is not impeded in expiring by the presence of water. The next best step in the process will be for Mr. Fleuss to show us how he charges the helmet. That is important, as proving how quickly he can charge it when it is exhausted. He can charge it sufficiently for all purposes of to-day in three minutes. The oxygen is brought, condensed in an iron bottle, by Mr. Orchard, of Kensington, and by a simple connecting tap and screw the helmet is charged from the bottle.

I refer specially to the simplicity of this plan, because I am anxious that the apparatus should be introduced into fire-stations, for the purpose of enabling firemen to enter houses on fire, when it is of moment that a man should be able to get ready quickly. The condensation of oxygen in iron bottles has been brought to such perfection in these days that there ought to be no difficulty in always having a ready supply of oxygen, and you will see the rapid manner in which the helmet is charged. Any working man, after two or three days' practice, could learn to charge the helmet in a few minutes for any purpose for which it might be required.

The next step will be for Mr. Fleuss to put on the dress and show how he prepares himself. While he is doing that, I will narrate to you some of the experiments which he was kind enough to allow me to perform. I have to thank the managers of the Royal Polytechnic Institution for their kindness in first inviting me to see this dress, and for permitting me to perform experiments in the diving tank in their large hall. I first thought that Mr. Fleuss had some means of communicating with the outer air, but that theory was disproved, and then, from physiological knowledge, I easily discovered the way in which he carried out his operations. We soon understood each other, and began to work. My object was to find out whether healthy life would be in any way impaired by living under these extraordinary conditions, in an atmosphere of oxygen artificially mixed with nitrogen. The first observation I made was on the 15th of November of last year, when Mr. Fleuss, in the course of one of his usual exhibitions in the tank, went to the bottom of the tank, and remained under water for an hour. The diving dress was adjusted at 6.33 p.m., and then Mr. Fleuss began to breathe through the apparatus. The question was whether the temperature of the body would be seriously affected by stopping for an hour under water, which, at this period of the year, was about three degree above freezing point, At the time he put on the dress, his temperature was quite natural, and his pulse was of good strength and tone, 72 in the minute. He said he felt the water colder lower down than he did at the surface. He descended at 6.40, and remained under water, at the depth of 12 ft., precisely one hour—that is, until 7.40. He walked about for the greater part of the time, picked up articles

that were thrown into the water, and once or twice reclined on the floor of the tank. At the end of an hour, he gave the signal to be drawn up, the coldness of the water having caused numbness in his hands. He walked up the steps, carrying the heavy weights of 116 lbs. After a short delay, first the helmet and then the mouth-piece were removed. I found the pulse 120 in the minute, and rather feeble; but there was no sign of suffocation, nor any symptom of danger. The breathing was quite free. The temperature of the body was 92° Fahr. He attributed the quickness of the pulse to the labour of carrying the weights up the ladder, and that, no doubt, was correct. Seven minutes later, the dress was removed, and warm clothing put on. The pulse was then 90, and the temperature 94°. The natural temperature is 98·4°, Twenty minutes later, the pulse was 80, and the temperature had risen to 96°, and very rapidly all the functions became again perfectly natural.

We have here a very remarkable experiment indeed, showing that a man can live, and apparently suffer no damage to his constitution, 6° below the natural temperature, for, in fact, he was at 92° when he first came up. I do not know how long that state could be maintained, because it is against previous knowledge and theory that for any length of time life can be maintained at that temperature. As regards the state of the circulation, I found that it was a little varied. I took readings of the pulse with a sphygmograph, and found it varied, but not materially. The pulse was made quicker and the strokes shorter, but not in any sense to cause a suspicion that there was any danger arising from the experiment.

On the 25th of November I made another observation. I filled the diving-bell of the Polytechnic Institution with carbonic acid gas, so that nothing could live in it a moment. A light was extinguished the instant it was put into the bell. Mr. Fleuss descended beneath the bell, and then ascended into it, and sat in it for the period of twenty minutes, quite protected from the effects of the carbonic acid gas. He was not affected in any way by that experiment. His temperature was 98° when he went into the bell, and his pulse 68; his temperature was 97½° when he came out, and the pulse the same as before—68. I next thought it would be well to try if vapours, that were of a very much lighter character than carbonic acid gas, could be tested in a similar manner, whether they would in any degree permeate through the apparatus in such a way as to interfere with the success of the method. To test this, I charged the diving-bell, still containing carbonic acid, with an atmosphere of amyl hydride—a very light gas, which passes into vapour below the temperature of the hand. No more crucial experiment could be tried. Mr. Fleuss entered the bell in this irrespirable atmosphere, remained 20 minutes, and then came out simply because the supply of oxygen began to fail. His temperature on going in was 98°, and his temperature on coming out was the same. His pulse was 72 on entering, and it was the same when he came out. In a word, he was unaffected altogether by an atmosphere, the inhaling of which would have put anyone who was unprotected to sleep, and probably to death, in 60 seconds, but in which he lived for 20 minutes with perfect impunity.

There are some questions now which arise as to how long a man can live in an artificial atmosphere made in the manner adopted by Mr. Fleuss. I must confess at once that the atmosphere is not strictly natural when we compare it with that which we breathe ordinarily, because there is always an excess of oxygen in the helmet. Of that I think there can be no doubt. Mr. Fleuss himself has two modes of determining what quantity of gas he requires from the helmet. If he feels that he has pressure on the drums of the ears he knows he has too much gas. If he feels that he has a slight sense of suffocation, then he knows he has too little gas. By the regulating tap he lets in or lets out the gas at pleasure. He is living in an excess of oxygen gas; and some years ago it would have been said that that was a condition which was incompatible with life—certainly incompatible with healthy life—and a very curious volume of research would have to be followed out by the scholar to see how this has been discussed, independently of Mr. Fleuss's experiments. Priestley, who discovered oxygen gas, thought life could be sustained in it. Beddoes, who succeeded Priestley, held much the same opinion, but later on some experimentalists found that when animals were placed in oxygen gas, and lived in it for a considerable time, they went to sleep. One of the most distinguised members of the profession of medicine of this country, Sir Benjamin Brodie, in connection with Mr. Broughton, who, I believe, still lives, made a very elaborate series of researches on this question. They placed animals in a bell charged with pure oxygen gas, put potash water beneath a false shelf, and had an arrangement by which they could wash the air constantly with the potash water, so as to remove all the carbonic acid from the atmosphere. The animals placed in this condition went to sleep, and died away in a very gentle and pleasant sleep. So it got into the text-books, that oxygen gas is a narcotic poison, although not an irritant narcotic, killing with convulsions or other violent symptoms. But in my early career in 1852, it occurred to me, on reading these experiments, that the experimentalists had not removed all the carbonic acid, and I thought that the carbonic acid was the cause of the sleep in these animals. To be quite sure of the matter, and to know how the experiments were performed, I called on Sir Benjamin Brodie, who was kind enough to see me, and he told me that, in his opinion, it was quite impossible that the animals died from carbonic acid, and he adduced the evidence of Professor Brande, of the Royal Institution, who had made an analysis of the oxygen from the chambers, and declared that there was no carbonic acid present. I then went to work in a different way to what had before been done. I placed warm-blooded animals in small glass houses to breathe pure oxygen, but instead of removing the carbonic acid in the way above named, I passed the oxygen in a constant current through the houses in which the animals lived, so that the oxygen was always freshly supplied, and the carbonic acid was removed as it was formed. In this manner I found the oxygen was not a poison at all; at the ordinary temperature of 65° to 70° an animal would live just as well in this oxygen gas as in the common atmosphere. I found, however, that if there was a difference in the temperature—

if the temperature were much lowered—then the peculiar sleep came on; while if the temperature were raised to summer heat, then there was an increased oxidation in the animal's body, so that a great deal of food was required, and wasting was very easily induced. Beyond these two facts of the influence of heat and cold, however, I found that oxygen gas was not a poison.

Curiously enough, another observation came before me. It was a very expensive experiment to make 80 or 100 gallons of pure oxygen a day, and pass it through these chambers to be lost, so it struck me one day that I would save the oxygen which passed over from the chamber, and would use it again. I therefore received the oxygen into another reservoir, after it had passed through the chamber in which the animals lived, and, having thoroughly washed it from carbonic acid, and every other foreign product that could be conceived, I used it again. To my great surprise, I discovered that, after being used twice in this manner, the oxygen lost the power of sustaining life so well as when freshly made. Why such should occur is yet a mystery. Whether some narcotic product is produced by the animal which diffuses through the oxygen, and which is not detectible, or whether the oxygen itself is changed in character by being breathed by the animals and exhaled, I cannot answer. But another result came out, and it was this: that if the oxygen which had been devitalised, to use a common term, were charged with electricity, simply by passing electric sparks through it from an induction coil, or a frictional machine, it immediately had restored to it its vital power, so that the animals lived as well then as they did in the fresh oxygen.

We may, therefore, say that, except under the extreme conditions of extreme heat and cold, Mr. Fleuss's system is a perfectly safe one for life, always supposing that he makes his oxygen fresh on every occasion, as he now does.

My researches on oxygen led me to another inquiry, viz., as to what was the use of nitrogen in the atmosphere. We know that nitrogen exists in the proportion of four parts to one, and the common impression has been that it is necessary in the air, to dilute the oxygen, and that the oxygen would actually destroy life if it were not diluted. My theory is, that there is another intention for the presence of the nitrogen—a theory I brought out in the year 1869. My idea is that nitrogen is present to meet the variations of temperature. For instance, if I took an animal from a temperature of 60°, and placed it, not in cold oxygen, but in cold common air at 30°; if I fed it well, and covered its body closely; if, in fact, I placed it in the condition of a well-fed Esquimaux, I found the animal would want to take largely of food—would begin to make an excess of carbonic acid; and, if only fed as at 60°, would commence to waste. The reason for this is, that the oxygen is abundant in the air, and, at the same time, is sufficiently diluted to be able to combine with the blood and the tissues, and the result is a greater production of primary force, by which the animal is enabled, when well fed, to sustain the effects of the surrounding cold. If, from this extreme degree of cold, I move the animal to a temperature of 70°, still supplying it with common air, I find, if food be kept up, and all else be equal, the animal ceases to crave so much for food, produces less carbonic acid, and, with decreased waste, tends to grow fat. The reason for this is, that the oxygen diluted still for ready combination, does not meet the blood with the same degree of pressure, and the result is that the animal, which in the warmer medium does not require so free a production of force, produces less force. If, in repeating these experiments, I use pure oxygen instead of common air, the animal at the lower temperature will want no food, will make a minimum of carbonic acid, and will sleep and die from not burning; while the animal in the higher temperature will eat ravenously, get very hot, produce an excess of carbonic acid, and, if not largely supplied with food, would die from waste. The differences in the result of these experiments, as compared with those related before, are due to the absence of the equalising nitrogen, which, existing in the proportion of four to one in common air, resists just in that proportion the excessive action both of heat and cold.

The practical application of these principles to Mr. Fleuss's apparatus is, that there would be some degree of danger in using it in extreme cold or in extreme heat. The waste would be excessive in extreme heat, and that would lead to exhaustion. In long-continued extreme cold, the temperature of the body would go down, and there would be danger from that cause. I observed that was the case in the first observation made on Mr. Fleuss. The temperature went down to 92°, and the wonder was he could live so well in that temperature. Below that, it would not be safe, in my opinion, to use this apparatus in the manner in which it is now brought forward.

For the use to which Mr. Fleuss's apparatus may be applied, I think some improvements admit of being made. It strikes me that a feeding apparatus might be introduced. Mr. Fleuss says he can live in it as long as he can go without food; and I think, if there were a bottle containing food—liquid meat, or milk—within the cuirass, and a tube were passed upward through the mouthpiece, so as to come to the mouth, he might very easily take food and stop for a longer period under the water, perhaps for eight or ten hours. Another improvement which might be made would be specially useful for mines—that, viz., of having a telephonic arrangement, so that he could communicate with those above by means of connecting wires. Those are improvements which I think the apparatus will admit of in the future.

The conclusion we may arrive at is that we have an apparatus now at our command in which, under certain conditions, a man can live for a long time under water, and be capable of carrying out active movement with perfect freedom, in which also a person can enter into an irrespirable gas. The apparatus may be used for diving, but how far it will extend for that use exclusively, has to be proved. There is a great difference, I understand, amongst divers as to the distance below water at which Mr. Fleuss can work with his apparatus. He himself has been 25 feet under water with it, and has felt no embarrassment. He has walked 400 yards under water and felt no embarrassment; but whether he can go to the

great depths which some divers have gone with the ordinary dress, is a matter which remains yet for inquiry. It may interest you to know to what depths divers can go. Mr. Siebe has related that one diver, named Hooper, descended, near Cape Horn, actually to the depth of 200 feet, and remained working for 42 minutes; the extremest depth to which a man has descended. That man, it is said, descended seven times, and remained under water 42 minutes each time. The statement has not been confirmed by after-experiments, perhaps because no one has had occasion to go to such a depth, but the very able writer of the article on diving in the "Encyclopædia Britannica" shows most distinctly that in some experiments made in Scottish waters, a depth of 86 feet was obtained by the divers; so that we may be quite sure, from the observations then made, that 86 feet is an attainable depth. On theoretical grounds, Mr. Fleuss ought to do the same, but he has yet to win his spurs, to show that he can descend to that depth, and perform work the same as divers can who are supplied with air through a tube from above.

Whether the invention is to be useful in the way of a diving apparatus or not, certain it is, it may be very useful for many other purposes. It may be extremely useful, I think, for entering into houses that are on fire, and my suggestion will be that a dress be made of very light material for this purpose, and of a fire-proof material. That is to say, perhaps a felt dress, saturated in nephate of ammonia, and made in such a way that the limbs can move easily in it. Then I see no reason why a man should not enter into a burning house and fetch out persons who are being burnt or subjected to danger, without any danger at all, in so far as the bad air is concerned. Of course he could not resist great heat, nor the danger from falling materials, but he would resist the suffocating smoke and air. I believe that this will be one of the most admirable contrivances, and I should expect that the day will come when every fire-engine-room in London will be supplied with one of them. Again, I think the apparatus may be used with great effect in mines. I have already shown, by an experiment with Mr. Fleuss, in the most crucial form, that he can live in the most active narcotic atmosphere. That he could be let down into a mine at any time after an explosion and traverse wherever he could see, and ascertain what persons were there, and render assistance, I have not the slightest doubt. He could do that to any extent, if he could carry a light. There an improvement wants to be brought forward again, a light that will illuminate all round, and yet, at the same time, not set fire to explosive gas. Once more, he could enter wells and places where carbonic acid is being given off freely. The dogs in the Grotto del Cane die rapidly when they are put on the floor; Mr. Fleuss could lie down in the place all day, if he could feed himself, quite safely.

In conclusion, let me put before you one demonstration. I have been favoured by the Royal Institution with the loan of the glass chamber in which Professor Tyndall made the experiment of entering into smoke, using a filter-mask over his mouth. That chamber, which has, I suppose, a capacity of about 45 cubic feet, has been charged with carbonic acid. The whole of the atmospheric air in it may not be removed, but like the lower part of the Grotto del Cane, nothing could live in it. Mr. Fleuss will, however, go into it and set us at defiance, for he cares nothing about an atmosphere of that kind.

[Mr. Fleuss went into the chamber of carbonic acid gas, and remained a considerable time.]

There is one further advance which will probably be made on this, and that will be to fit up a small submerged vessel with propelling power, so that men may live in it under water and pass beneath the sea considerable distances, carrying with them their own atmosphere and food. When I once said that a great branch of geographical discovery made by the Salutlanders was the exploration of the floors of the great depths, I was very much laughed at; now, I think the laugh is going to be on my side, and that that achievement will even come to pass in the course of the next half century.

It remains, sir, for me only to express to Mr. Fleuss our debt of gratitude, not only that he should, with great labour, trouble, and expense, have worked out this ingenious apparatus to such perfection, but that, he should also, with true English courage and pluck, have been himself the first to experiment with it, and to enter into deep water, not knowing whether he should come out alive from the trial. It has been to me a work of much pleasure indeed, and I esteem it an honour to be connected with this apparatus, by giving the first lecture on what I am quite sure will lead to a new era in the art of living in factitious gases, and beneath the sea.

A vote of thanks was passed to Dr. Richardson at the conclusion of the lecture.

INDIAN SECTION.

Friday, May 7, 1880; Sir William Rose Robinson, K.C.S.I., in the chair.

The paper read was—

AGRICULTURE IN THE MADRAS PRESIDENCY.

By W. R. Robertson, M.R.C.A.

The peculiarities of the physical geography of Madras, and of the State's administration of the land, influence so greatly the character of the agricultural practice of the country, that I must, I regret, trouble you with a good deal more on these subjects than otherwise I should have considered necessary.

Physical Aspects, Soils, Climate, &c.

The Madras Presidency is the most southern of the provinces of India. Its northern boundaries are only about 16 degrees north of the equator, and, consequently, the climate is extremely hot. The province includes a greater area than Great Britain and Ireland together, while it has a population almost as numerous as these countries.

The eastern and southern portions of the Presidency are very flat, forming vast plains, broken in a few places by low ranges of hills. Near the coast

the land is only slightly raised above the sea level, but inland and northward it gradually rises until it forms extensive uplands, with an elevation of from 1,500 to 2,000 feet. On the western side of the province, and following the general coast-line, there are extensive ranges of high mountains; the Pulney hills, the Sheveroy hills, and the Neilgherry hills are branches of these ranges. There are several other ranges of hills, but they have a low elevation, and, unlike the higher ranges, are either quite bare, or are only scantily covered with scrub jungle. These lower hills are usually uninhabited, but on the higher mountains there are several thriving European settlements, the climate being remarkably well suited to the European constitution. It is on the sides and summits of these higher mountains that tea, coffee, and cinchona grow.

The mountain ranges consist chiefly of granite rocks, the decomposition of which, especially when potash-felspar is present, affords a good soil. The minor ranges of hills are composed generally of syenite and quartz rocks; the former, on decay, yield a moderately good soil, but the soils formed by the decomposition of the quartz rocks are inferior, and, when unmixed, are quite sterile. A considerable area of country is covered by sedentary soils, derived from inferior rocks; the soils of the uplands are chiefly these. The lower situated land consists, usually, of transported soils, formed of the disintegrated portions of rocks of various formations, with varying proportions of organic matter; these soils are usually alluvial, being composed of materials that have been washed off higher land during and after heavy rains, and afterwards deposited from the water. From the low position of alluvial land generally, water can be very readily brought to it, and such land constitutes the greater portion of the irrigated area. The land thus best fitted, both chemically and physically, to dispense with the aid of irrigation water, gets most water; the poor uplands, that are robbed of fertilising matter by every heavy shower, seldom getting any aid from irrigation, from the difficulty and expense of conducting the water to the height required.

A black soil prevails extensively in many parts of Madras, which resembles very closely the black soils of Russia. The origin of this soil is involved in great uncertainty, but it is usually supposed to have been deposited under water. This black soil is found in isolated patches of only a few acres, and also forming extensive plains of many miles in extent. Being moderately fertile, and possessing great powers of absorbing and retaining moisture, this soil is much valued by native cultivators, chiefly for growing cotton; hence the name, "black cotton soil," by which it is generally known.

Another important variety of soil that prevails extensively in some parts of the peninsula is a volcanic soil, of a red or chocolate colour. It is usually fertile, easily worked, and is fitted for all kinds of crops suited to the climate.

As I have already noticed, however, inferior soils, derived chiefly from quartz rocks, prevail far the most extensively throughout South India, and it is soils of this class which constitute the greater part of the land that, in recent years, has been added to the arable area, and which, being tilled in the same rude way as the better soils, that previously only were cultivated, has failed so utterly in yielding crops that repaid cultivation expenses, whenever the seasons have been at all unfavourable.

The general slope of the country is towards the east, all the chief rivers flowing into the Bay of Bengal. With the exception of the half-dozen large rivers, the rivers of Madras seldom continue to flow for a period longer than four or five months after the rains of the monsoon. All the rivers contribute largely to furnish the water required for irrigation, though, in some instances, not nearly to the extent possible. The large rivers depend chiefly on the rains of the south-west monsoon for their supplies. I should mention that Madras enjoys two monsoons, the south-west and the north-east. During the south-west monsoon, the rainfall is very great; but the heavy rains do not extend far inland, the greatest portion of the watery vapour brought by the monsoon winds being intercepted and condensed by the western mountain ranges, on the west slopes of which, and on the strip of country near the coast, the rain is precipitated in torrents. The average annual rainfall at some of the stations in the country west of the mountains is as much as 150 inches, while, on the opposite side of the mountains, 30 or 40 miles away, the fall, in some instances, is not more than from 25 to 30 inches in the year. However, the crops raised on a considerable extent of country depend on the rains of the south-west monsoon. The monsoon begins to blow about the middle of May, and continues, with varying force, until the middle or the end of July.

The north-east monsoon begins to blow about the middle of October; the wind comes laden with watery vapour, gathered in passing over the Bay of Bengal, and discharges the heaviest portion of this burden on the coast districts, the amount of rain precipitated being less and less as the wind progresses across the Presidency — some of the inland districts thus not getting more than 15 inches, while those at the coast get as much as 35 inches. This monsoon ceases about the middle of December.

A small area of country is partially watered by the rains of both monsoons, but both rains cannot always be relied on. It is only when either monsoon is unusually heavy that the rains overlap to an extent sufficient to meet the requirements of agriculture.

The cropping season, in different parts of the Presidency, begins with the advent of the monsoon that portion of country is under. In the western and north-western portions, the sowing season is in May and June, and the harvest takes place in October and November; while, in the eastern and southern parts of the Presidency, the sowing season is September and October, and the harvest is gathered in February and March.

The unequal distribution of the rainfall, rather than deficiency, is generally what agriculture suffers from. The driest district in the Presidency has an average annual fall of over 20 inches, while 12 of them have a yearly fall of more than 35 inches; one having an average fall of 110 inches, and another 150 inches.

It is a very common experience, in South India, for the country to suffer from drought and flood within the same month; that is, a severe drought may extend over twenty-nine

days of the month and on the thirtieth day there may be a downpour of rain, flooding all the low-lying country. It is this uncertainty in the fall of the rain, that necessitates the employment of tanks for storing the surplus rain of one period for use at other periods. Unfortunately, no satisfactory provision has yet been made, except as regards small areas of country, for storing the surplus water of the rainfall; and hence a very large proportion of the water that thus falls is unutilised, and flows away into the sea. To store all the surplus water that falls in rain would be impracticable, but a very much larger quantity might be stored than there ever is now. This matter demands the most serious attention of all interested in the welfare of South India.

As I have before noticed, the temperature is always high throughout Madras, the mean daily temperature in the shade varying from 75 to 90 degrees in the year. The thermometer, freely exposed to the sun, will sometimes register as high as from 150 to 160 degrees. On the hill plateaus, at elevations over 6,000 feet, the average temperature is about 30 degrees lower than on the plains. It is the continued heat, rather than the occasional great heat, that proves so hurtful to the health of Europeans who are obliged to reside on the plains. There is no really cold season in Madras, though the weather in December, January, and February is usually very agreeable, after the great heat of the other months. Of course, no European could with safety employ himself in out-of-door agricultural duties during the whole day, at any time during the year, on the plains.

The beneficial influences that forests have on the climate of tropical countries is well known. In Madras, unfortunately, there is comparatively but a small area under forests, and this is chiefly on the slopes of the higher mountains. There are on the plains considerable tracts under scrub jungle, but the area so occupied is being rapidly lessened. During the last twenty-five years, fully eight million acres of land, partially covered by this scrub jungle, has been cleared and brought under the plough. The effect of these extensive clearings cannot but be prejudicial in lessening the amount of moisture in the air and soil, for the land is only shallow ploughed, and is under crop only for about five months in the year; thus being quite bare about seven months in the year. Engineers say that, after heavy rain, water flows off the land in certain localities far more rapidly now than formerly, and that the arches of many railway bridges, which at one time were sufficiently large, are now too small for the flooded state in which the rivers occasionally get. And ryots assert that many rivers, which formerly flowed for five months, now rarely flow for more than from three to four months in each year. There can be no doubt whatever but that the conversion of jungly tracts into half-tilled arable land—that lays bare during more than half of the year—must facilitate the passage of the water, that falls on the land during heavy rains, into the bed of the nearest stream. Deeper tillage, and the employment of organic manure in manuring the land, would enable such soils to take up and hold a much larger quantity of water than is possible under present circumstances. Not only is much water now lost, that the land might, under good treatment, absorb and store, but disastrous floods are sometimes produced.

The Administration of the Land by the State.

The average gross revenue obtained by the State annually from the land—as rent, quit rent, &c.—is four million pounds, or fully half of the gross annual revenue from all sources. The estimated area of the Presidency is eighty-four million acres, of which about twenty-one million acres are held under the zemindari tenure. The remainder of the area is classed as inam land and ryotwari land; about eight million acres under the former, and fifty-five million acres under the latter.

Zemindari estates are usually very extensive, sometimes comprising hundreds of square miles of country. The land is held by the zemindar, subject to the due payment of a fixed sum annually to the State; this sum is usually far below—sometimes not more than 30 per cent.—the amount the land would yield if it were let direct to the cultivators. Some of the great estates were in existence when the country first came under British rule, but others have been established since, under the belief—long ago proved to have been erroneous—that the zemindars thus created would constitute a class somewhat resembling the country gentlemen of England, and would live on their estates, and use their best endeavours to secure the improvement of the land. These expectations have not been realised. Zemindars take but little interest in agricultural pursuits; indeed, it would be difficult to point to a single zemindar in Madras who acts up to what, in this country, is considered to be the duty of the landed proprietor who rents his land to tenants for cultivation; and the zemindari tenants, it must be remembered, are almost exclusively tenants-at-will, without any rights that they can enforce. The condition of the country under the zemindari tenure is in no respect superior—indeed, is frequently inferior—to that of the country held under the ryotwari tenure, which, acre for acre, yields the State a very much larger revenue.

Inam land is land held subject to the payment of a small (usually nominal) quit rent, granted in recognition of services done the State. A large number of these grants were made by former Governments. There is nothing to distinguish the farming of the inam land from that of the land under other tenures.

The ryotwari tenure is now the chief land tenure of the Presidency. Under this tenure, the land is rented direct from the State. Possession of the land can be retained only as long as the rent is regularly paid. When the rent falls into arrears, it is usually recovered (with all charges, and interest at six per cent.) by the rent-collector selling the right of occupation of the holding to the best bidder, as well as the personal property and live and dead stock of the defaulter. When these measures do not suffice, the debtor is imprisoned, when (if he has any friends, or any credit) he usually manages to find the money needed. Imprisonment does not extinguish the debt.

The ryot is permitted to sell, lease, or mortgage his right of occupation, but the State gives him no title-deeds; he is furnished with a puttah, but this (in the law courts) is considered very weak

evidence to prove possession—it is merely a document showing the extent of the holding in the year in question, and the rent to be paid. Though the State has the right to fix the amount of the rent at its discretion, it does so in accordance with rules it prescribes, but without any reference to the views of the tenants. It is generally assumed that the annual rent should represent half the net value of the produce of the land. The rent is supposed to be unalterable during periods of thirty years. The rent is usually fixed for the land as unirrigated, and if irrigated an extra charge is added. Large departments are maintained by the State for surveying the land, and determining the classes in which it should be placed for rent. The rent settlement department costs, on the average, £30,000 annually. The work it performs is carried on in accordance with most elaborate rules and regulations, but the data used is purely empirical. A knowledge of agriculture or the physical sciences is not deemed more necessary for officers of this department than for those in the judicial or the financial departments. The native subordinates who classify the soils are, as a rule, uneducated men, receiving wages at the rate of about £10 or £12 a year.

There are many classes, or grades, in which the land is placed; according to its supposed fertility, its nearness to a good market, &c. When the land is being valued for rent, the rule usually followed is:—From the money value of the estimated outturn deduct one quarter, as an allowance for bad seasons, and from the remainder deduct the cultivation expenses, and thus, the net value of the product will be ascertained, half of which forms the rent to be paid to the State. It will be observed that the system followed in determining the rent to be charged gives no countenance whatever to the extreme views held by some regarding the position the ryot holds in respect to the land he occupies. Nor does it allow any deductions in calculating the amount of the rent, for the interest on the sum the ryot may have paid the outgoing tenant for the right of occupation—sometimes as much as £3 for unirrigated, and £15 for irrigated land per acre. Were the sale of the right of occupation recognised by the State, the rent would frequently be very small, after deducting interest on the sum expended on its purchase.

As the character of the crop is the basis for determining the rent at the time of settlement, ryots complain that, if crops are cultivated with skill and under proper conditions, the occupiers of the land are punished by having their land classed in a high grade; whereas their neighbours, who may fail utterly in performing their duty towards the land, are favoured by their land being placed in a lower class, and the rent demanded being consequently smaller. The State disclaims any intention of profiting by claiming an increased rent for any improvement, such as a well, the ryot may make; but a good deal more than this is necessary in order to protect an improving tenant. Under the rent settlement rules now in force, a premium is offered for bad farming.

The rent should, I think, be estimated with reference to the value of the produce the land will yield when fairly well farmed; at present, the worse a man farms, and the worse crops he raises, the lower is the rent he is charged. It would, I think, be reasonable, if, when settling the rent value of a tract of country, after it had been ascertained what ordinary crops the prevailing soils are suited to produce, and the average yield of the crops under reasonably good farming, that the State should declare that ever afterwards the data thus determined shall be used, in calculating the amount to be charged as rent, at the re-settlement at the close of each period of 30 years; the only data used in fixing the amount of the rent liable to vary would thus be the average price of the produce in each of the 30-year periods. Under such a system an enterprising tenant might, without risk, farm highly, and might substitute the more valuable for ordinary crops.

The rent charged by the State for the land belonging to it is, however, very low, especially that for irrigated land. The result is, that many Government tenants sublet their land, and live idle lives; the income obtained by subletting the land, over the amount that must be paid to the State, being sufficient for their wants. As will readily be supposed, the land is thus greatly ill-used, being in the hands of rack-rented subtenants, generally without capital. Although the rent is payable in silver, and this metal has depreciated fully 20 per cent. in value in recent years, no increase has been made. The average rent over the presidency has been greatly reduced in the last 25 years; thus, for the five years ending 1856-57, the average for irrigated land was 13s., and for the unirrigated land 2s. 6d., while the average for the five years ending 1877-78 was, for irrigated land, 9s., and for unirrigated land, 2s. These reductions in the averages are, however, not the result of any reduction in the rent, but result from the large addition of inferior, low-rented land to the area previously cultivated, thus bringing down the general average.

It must be apparent to all who have given any consideration to the matter, that the State is directly interested in its land being well-farmed, not only because bad farming lessens the revenue the land yields, but also because when bad farming is the rule, unfavourable seasons prove far more disastrous than otherwise they would; and the people depending on agriculture become dependent on the State, now that it has accepted the responsibility of insuring them against the effects of famine, special taxation being instituted to raise a portion of the funds needed. I venture to think that, in assuming this new responsibility, the State might reasonably, at the same time, have insisted that the people should neglect no means within their power to protect themselves from the effects of adverse seasons. It is estimated that the recent famine in Madras cost the State in direct outlay, and loss of income, an amount equal to the net revenue obtained from the land in three ordinary years, and there is no certainty that within the next five years the Presidency may not undergo a similar experience; indeed, the conditions which make a famine possible in an adverse season are now present in a more intensified form than previous to the late famine. That famines are likely to occur with greater frequency and severity in the future, constitute the grounds on which the financial member of the Government of India recently insisted that a special provision of a permanent kind should be made, to meet the

cost of famine relief. He expressly stated that famines can no longer be considered as events of an exceptional character.

The failure of the State in promoting its own interests, by improving the agricultural practice of its tenants, is not due to the absence of the means for exercising the necessary supervision, for it possesses a vast organisation for the management of its land, the current cost of which is—

Village Establishments.....	£470,000
Taluc ,, ...	146,473
District (less one-fifth chargeable to Justice).....	266,540
Board of Revenue Establishments ..	17,856
	£900,869

The gross annual land revenue is four million pounds, so that the expenses incurred in establishments for collecting this revenue represent a charge of 22½ per cent. on the amount of the rent-roll. In this country, as in Ireland, where small farms prevail, estate management rarely costs more than five per cent. on the total rent demand, and the management embraces a supervision over the condition of the property, and is not confined, as in India, to rent-collecting duties.

It is true that the district officers have many other duties besides those connected with the land, but, though troublesome, they are of minor importance, and I have already deducted from the annual cost of the district establishments one-fifth, as the proportion usually chargeable against Justice.

The character of the State management of the land will be appreciated, when I mention that a knowledge of Greek plays is deemed a more necessary qualification than a knowledge of the principles of agriculture, in one employed in land administrative duties. In making this statement I do not wish it to be inferred that none of the officers of the Land Revenue Department possess any knowledge of agriculture, for some do possess a fair knowledge; but what I do desire to bring to your knowledge is the fact that, while the State demands of those who would enter its service as land administrators evidence of a thorough knowledge of a very large number of subjects, agriculture is not one of these subjects. I have frequently heard officers, entrusted with the charge of districts as large as English counties, express deep regret that—from the want of a knowledge of the principles of agriculture—they were unable to be of the use they might otherwise be, in advising and encouraging improvements in the agricultural practice of their districts. Candidates for this special branch of State employ should certainly devote a portion of their probationary period of training to the study of agriculture, even should it be necessary to abandon some of the subjects they are now bound to study. A year at the Royal Agricultural College would suffice, and the year need not be given up entirely to agriculture, for the physical sciences, language, and law might (if special arrangements were made) be studied as well at Cirencester as elsewhere. A probationary period of special training, with State allowances, has been arranged for approved candidates for the Forest and Engineer Departments.

The Farming of the Unirrigated Land.

No agricultural statistics are collected by the State for the tracts of country held under the zemindari tenure. The observations I am about to make must be understood as applying to what is called Government land, that is, land held under the ryotwari and inam tenures.

In spite of all that has been done to increase the area of country protected by irrigation, fully 80 per cent. of the occupied land under notice is yet without this protection. It is important to note that the unirrigated area has, in the past 25 years, been increased about seven million acres. The irrigated area has also increased, but not to the same extent.

If I am correct in believing that the persons added to the population in the 25 years in question, numbering about nine million souls, have had to depend greatly for food on these additional acres of unirrigated land, consisting largely of inferior soils, it is not at all surprising that the price of food should have so greatly increased, and that, in unfavourable seasons, the people should have suffered so severely.

The unirrigated land is not all inferior; some of it is productive, especially that composed of the black and red-coloured soils, when situated where the rainfall is fairly satisfactory. Under good tillage, these soils might, especially if manured with organic manures, be made almost as productive as much of the irrigated land. The bulk of the unirrigated land is, however, very poor; so poor, indeed, that no person who has not a personal knowledge of it can form a proper conception of its extreme poverty. Much of the land could be cultivated only by a race whose houses can be built for a few shillings each, who can be clothed for five shillings a head, and who, when necessity arises, can starve themselves down to, and exist on, a single meal in the day. Much of this land does not yield more than six or seven bushels of grain per acre, and this only of inferior varieties of cereals, but little removed from the ordinary grasses.

The holding of a ryot is not a fixed piece of land, like the holding of English farmers; the site or the area may be changed almost at the pleasure of the ryots if land is available. As most of these holdings are without any permanent erections on them, and are usually without trees or fences of any value, and as the ryot seldom engages in carrying out improvements on unirrigated land, any desire that he may have to relinquish any of his land, or to change the site of his farm, is unfettered by the considerations which, in more civilised lands, compel farmers to confine their operations to fixed areas of country, and concentrate their best endeavours thereon, in view to effect such improvements as will enable the largest crops to be produced at the least expense, and with the least injury to the soil.

The increased area of land under crop in each year has, of course, in later years, greatly restricted the action of the ryots in exchanging, for fresh land, any land that may be becoming exhausted, and the appropriation for tillage of such a large portion of the area previously unrented has lessened the ryots' resources, in reducing the area of free land on which their cattle procured a scanty

subsistence, and which enabled the ryots to get manure more readily for the rented land. From this stand-point the greatly increased area now under cultivation is not a ground for congratulation, as some seem to imagine; native agriculture depends entirely on the unoccupied land for support.

The ryots of a village may never pay rent at one time for a larger area of land than 200 acres, and yet, in a course of years, may temporarily exhaust the fertility of hundreds of acres in the neighbourhood. Of course, this spoliation of the land can be carried out only on that situated within a reasonable distance from the villages.

It was by thus frequently changing the sites of their holdings, that the ryots have been enabled during so long a period to support themselves by the results of their rude husbandry. Had each cultivator been obliged to keep to a given area of land, like the farmers of this country, the exhausting character of the husbandry practised, would speedily have reduced the soil to a condition unfitted to yield even the scanty produce the ryot has continued to get. I am particularly desirous of putting this matter before you in as clear a light as possible, for statements are frequently made to the effect that, in India, even the unirrigated soils have been tilled without manure for ages, and that, even now, the soils remain productive; as if the ryots could set aside natural laws. It was, of course, only the unirrigated land that was relinquished or exchanged in the manner I have noticed. The irrigated land is usually laid out at some considerable expense, and, moreover, the area of country suited for irrigation, as usually practised, is very limited. If irrigated land gets into a bad physical condition, it is usually readily restored by a slight rest from cultivation, or by being cropped with a non-irrigated crop; as such land is generally supplied with silt in the irrigation water, it is more rare to meet with it in an exhausted condition.

The ryots generally state that unirrigated soils have become much less productive than they were. I have heard some experienced men assert most positively, that in the past 30 years, this diminution in productiveness is fully 30 per cent. I often have had opportunities of discussing this, and other questions relating to agriculture, with the ryots on their own holdings, and have found that, generally, they agreed in stating that the unirrigated land had become far less fertile in later years, while that there was no apparent change in the productiveness of the river-irrigated land, from its being supplied with silt. There can be no doubt but that unirrigated land is rapidly becoming poorer under ordinary native farming, where, as is now the case over so large a portion of the country, fresh land—I say nothing about virgin soil—is not available for exchange for that temporarily exhausted. As I have endeavoured to show, the exhausting influences of native farming become intensified in their action when the ryot is compelled, for the reasons noticed, to confine his operations to one piece of land; not only because more is taken out of that piece of land, but because he must rely for manure on the dung of the cattle maintained on old land instead of the dung of cattle grazed elsewhere. But when this stage is reached, an opportunity is offered for introducing reforms, with a better prospect of their being adopted; of these, the growth of green crops for consumption on the holding is not the least important.

Shallow tillage prevails over the whole of South India; it is as rare there to meet with land tilled to a greater depth than 4 inches, as it is in this country to meet with land tilled deeper than 12 inches. Observant ryots cannot but be aware of the beneficial results that arise from deep tillage; but, then, it is not the custom to till the soil deep, and agricultural customs have almost acquired the force of religious observances in India; indeed, the practice of husbandry is very intimately connected with the religion of the people, and hence the difficulty in introducing any changes.

The implement generally used for performing tillage operations is the native plough; but, as it merely stirs and loosens the soil, without lifting or turning it, the operation is that of a cultivator rather than that of a plough. This plough is similar to those in use in most countries where the modern plough has not yet been introduced; it is made of wood, has a share made of iron, is unprovided with a mould-board, and is without any arrangement for regulating the depth or width of the furrow. Of course, with such a plough, it is impossible to ridge or invert the soil. An ordinary cultivator would perform the work of three or four native ploughs, at less cost, and do it far more efficiently. When at work, the plough makes a furrow with a V-shaped section; the section of the furrow made by a modern plough is usually rectangular. The native plough, when in operation, seems to be doing far more work than it really is. When the ploughed land is examined, it is seen that little more than a third of the bulk of the soil to the depth the plough has gone is moved; the surface is stirred, but below there are ribs of unmoved soil. Natives are aware of this defect in the work done by their plough, and cross the land two or three times in order to ensure that the soil is moved.

The test of the work of a plough is the amount of soil it will turn over at a given cost. A native plough, working under favourable conditions, will make a furrow having the following dimensions:—Depth, 4 inches; width at top, 5 inches; width at bottom, 1 inch; and the section will have an area of 12 inches. In an ordinary day the cattle may turn about sixteen miles of furrow, thus moving about 260 cubic yards of soil. Valuing the labour of the cattle and the man at the usual rates—9d. per day for the former, and 4d. per day for the latter, and charging 1d. per day for replacing the plough when necessary—we find that the cost of moving 1,000 cubic yards of soil by means of the native plough is 4s. 5d. The average dimensions of the section of the furrow made by a modern plough, such as I recommend, working under similar conditions, may be taken as—depth, 6 inches; width, 9 inches; and the area of the section of the furrow will be 54 square inches. An average day's work is three-fourths of an acre; so that, in a day, the plough will move 600 cubic yards of earth. The daily cost of the plough may be taken as—Hire of cattle, 1s.; hire of ploughman, 4d.; charge to pay interest on the cost of the plough, and to replace it when worn out, 3d.; total daily cost, 1s. 7d. —or, for moving 1,000 cubic yards of soil, 2s. 7d.;

that is, the work would be done at 40 per cent. less cost by a modern plough. In the estimate I have charged more for the hire of the cattle needed for the modern plough, because somewhat better cattle would be required for it than those ordinarily in use, though not better than are used for ploughing in many districts of Madras.

Of course, as the cattle generally used for ploughing in India are small, large ploughs are unsuited. Iron ploughs, or wooden ploughs with iron working parts, weighing from 60 to 90 lb., and with a draught of from 200 to 250 lb. when turning a furrow 9 inches wide by 6 inches deep, in a free soil, are suited to the capabilities of the cattle obtainable in many places at moderate prices. People make a great mistake who take it for granted that, because the native plough is comparatively light in weight, its draught when at work is necessarily light. I have found ordinary native ploughs, when engaged in their usual work, register a draught by the syranometer of from 250 to 300 lb. Owing to their bad shape, many native ploughs, though they may weigh less than the lightest modern ploughs, have frequently a much greater draught, though performing much less work. But, says the opponent of the modern plough, where are the ryots to get the money required to enable them to buy modern ploughs? Well, it is certainly true that many ryots cannot raise the money needed, but there are thousands who could readily afford the money. However, it must be remembered that a modern plough will, at the least, perform the work of two native ploughs. If, therefore, money cannot otherwise be raised to admit of the purchase of the modern plough and the pair of somewhat better cattle needed, it can be obtained by the sale of the two pairs of cattle and the two native ploughs. Thus—

Credit.	
Sale of two pairs of cattle and two ploughs	£9
Debit.	
Purchase of pair of good cattle.....	£6
Purchase of a modern plough	£3
	£9

In adopting this arrangement, there will be the hire of one man and the food of one pair of cattle saved. Of course, in some holdings, it might prove somewhat inconvenient to carry out the arrangement; but, generally, no inconvenience would be likely to arrive.

Ploughs of the modern shape can be made quite as portable as the circumstances of the country require. Repairs to such ploughs can be effected by ordinary village smiths, after undergoing a little training. At the Saidapet Experimental Farm, the native smiths can not only repair ploughs of the modern kind, but can make them. Natives readily learn the management of the modern plough. At Saidapet upwards of 200 acres of land have been worked for the past ten years by these ploughs; each is drawn by a pair of cattle, and driven by a single native ploughman. At the public ploughing-match held in February last, the five men whose names were at the head of the award list, obtained an average of over 80 per cent. of full marks, and ploughed at the rate of over an acre per day, all using modern ploughs.

I have dwelt at this length on the subject of ploughs because I consider it of great importance. I believe there is nothing which will have a greater effect in improving native agriculture than the introduction into general use of modern ploughs. As I have already noticed, the tillage of the soil is effected by means of the native plough; rollers, harrows, &c., not being used. If a fine tillage is required, the only way to secure this known to the ryot is by repeated ploughings.

Were the soil more deeply and more thoroughly tilled, the crops would be less exposed to danger during a moderate drought; their roots would grow deeper into the soil, and would thus not only be less exposed to the fierce heat of the sun, but would have a larger volume of soil in which to feed, while a larger quantity of the rain would be absorbed and stored in the soil, and the dew and the watery vapour resting over the soil at night would be appropriated to a larger extent. The fact that deep tillage, combined with the use of organic manures, will enable crops to be grown even in the dryest seasons, was shown in a decisive manner on the Saidapet farm during the Madras famine. It is well to remember that there is a difference between deep tillage and deep ploughing; for, while the latter may temporarily do injury to soils of a certain character, deep tillage never can do any harm.

Instead of compensating his soil for its imperfect tillage, by applying to it liberal dressings of manure, the ryot's management fails in doing this, even to a greater extent than it fails in the mechanical treatment of the soil. The only manures used by the ryot are those formed of the dung of domestic animals, green vegetable manures—in the form of leaves of trees and bushes, wild plants, crops ploughed in, &c.—and ashes. Other manures are procurable at moderate prices; bones at about £3, oil-cake (castor oil) at about £2, saltpetre at from £10 to £12 per ton. Lime is generally difficult to get, and, on account of the high price of fuel, is costly; the usual price is about 30s. per ton. However, the ryot uses none of these manures; the saltpetre, bones, and oil-cake are exported, either to the coffee districts or abroad. In the cultivation of tobacco, indigo, sugar cane, and similar valuable crops, the ryot could well afford to use these manures, but he never does. He equally neglects other useful manures, usually easily procurable at no expense beyond the value of the labour employed in their collection. Of these, I may mention night-soil, the refuse of indigo factories, town sweepings, refuse of slaughter-houses, refuse of brick-kilns, tank mud, &c.

There is, perhaps, not one hundred acres in all Madras manured with night soil; as nearly the whole of the grain produced on the unirrigated land is consumed by the people of the country, the night-soil should suffice for manuring the greater part of the grain-producing land; but, instead of being used as manure, human excrements are allowed to pollute the neighbourhood of every village; near some, it is impossible to camp, the effluvia is so abominable. The excreta-saturated surface soil, after every fall of rain, gives off pestilential miasma, and poisons the air; while, not unfrequently, after rain the drainage-water off the land flows into the village tank, upon which the whole of the villagers have to depend for drinking water.

In the larger towns, the authorities have succeeded in improving matters somewhat, by having the excreta collected and buried under ground; but the neighbourhood around many of the smaller towns and villages is frequently in a most disgusting condition; the consequence, of course, being outbreaks of cholera, small-pox, fever, &c. In some of the villages, infectious diseases due to bad sanitation are nearly always present, and the field labourers lose a good deal of time from sickness. Owing to the great dryness of the climate, during, at the least, nine months in the year, night-soil can readily be prepared in a form fitted for use as manure; its admixture with ashes, and its storage under a leaf-shed for a few months, usually suffices to secure its thorough deodorisation.

The refuse of indigo manufactories is well suited for manuring land cropped with indigo; the refuse represents all that is removed by the crop except the dye, and this is purely vegetable. But the liquid from the tanks is usually allowed to flow away, and the refuse plant frequently becomes a nuisance near the factories. I was consulted, not long ago, by an extensive indigo manufacturer, who stated that within the past twenty years the crops of indigo produced near his factories had so lessened in yield that they now scarcely sufficed for his requirements, and he sought advice as to the substitution of some other crop for indigo. On inquiry, I ascertained that none of the refuse indigo plant was returned to the soil, some being burnt, and the remainder thrown into the river, as the ryots refused to cart it back to their land, though it was offered to them free of cost. The land being cropped without manure, its failure to yield good crops was only what might have been expected.

The authorities of many towns experience very great difficulties in getting rid of the refuse of the towns when collected. In many instances it is disposed of by using it for filling up old tanks, or raising the surface of low-lying land. Near the city of Madras thousands of cart-loads are annually disposed of in this way. Near some towns and villages, vast masses of this accumulated refuse are forming; and yet, close at hand, there are large areas of land cultivated altogether without the aid of manure, and, of course, producing very indifferent crops.

Refuse of slaughter-houses is not available to any great extent, except in the large towns. In the city of Madras, 220,000 sheep and 8,000 cattle are slaughtered annually, the whole refuse offal of which was wasted, until about two years ago.

Brick-kiln ashes are valuable, chiefly because they usually contain ashes of cattle-dung and wood, used as fuel.

Tank mud consists of fine silt that has been washed off land by the surplus rain water in flowing to the tank.

In the face of these facts, there are officials employed in the administration of the land who assert that the ryot applies to his soil all the manure he can possibly procure. Such men have usually obtained what little knowledge they possess of agriculture from the ryots, and, of course, view the matter from the same stand-point. Even were it the case that no other manure than the excreta of cattle and sheep could be procured, there is plenty of evidence to show that even these are not properly utilised. The urine, the most valuable portion of the excrements, is, except when the animals are folded on the land, almost invariably wasted, from the non-employment of suitable litter for bedding the animals when tied up, and a very considerable proportion of the cattle-dung is dried and used as fuel. Sheep-folding is adopted to a large extent; but, as the sheep penned at night on the land get no other food than what they can pick up on the waste land in the neighbourhood, their excrements are, of course, far inferior to those of well-fed sheep.

There are some who have ventured to assert that the use of cattle-dung as fuel is not an agricultural evil. But such persons can possess no personal knowledge of the conditions under which agriculture is carried on in South India. It is true that the dung is very poor in fertilising matters, from the poverty of the food of the stock, and that, if the ashes made in burning the dung are carefully collected and husbanded, they will contain a great part of what fertilising matter that the dung contained. But, in burning, the organic constituents of the dung are all dissipated and lost, and it is these organic matters that prove so efficacious, in poor, shallow-tilled soils in increasing their powers of absorbing and retaining moisture, and in facilitating the appropriation of the fertilising gases of the air. Every intelligent farmer is aware that the few handsful of ashes, to which a cart-load of dung is reduced on being burnt, has nothing like the fertilising effect the load of dung possesses. But, were it the fact that the soils of the ryot are already sufficiently rich in such organic matters as are found in dung, to admit of their dispensing with further applications, we have yet to take into account the facts that in order to get the dung for burning, the whole of the fertilising urine is usually lost, and that the greater bulk of the ashes made when the dung is used as fuel are also lost to agriculture—an agriculture, it must be remembered, that depends on the dung of farm stock. The live weight of farm stock maintained per square mile of territory is less than a fifth of that maintained per square mile in England, where all the excrements of the farm stock are used as manure, and vast quantities of other manure—the refuse of manufactures, and manures imported from abroad.

Cattle-dung is used as fuel, chiefly in the large towns and villages, and is largely used by persons who have no connection with agriculture. It is generally employed for household use, but is also used by brick-burners and others. I have ascertained, by direct inquiry, that in many native households the consumption of cattle-dung as fuel is equal in amount to that made by one bullock for each adult forming the household. The ashes, instead of being carefully stored under cover, are simply thrown out of doors along with other household refuse, to remain until removed by the scavenger to the rubbish depôt, or carted to the field, if so required, at any time convenient. The result is, that the most valuable portions of the ashes are washed out by rain, and the ashes get largely mixed with valueless matters, rendering their manurial value very small—a fact the ryot seems to recognise by the low value he attaches to the ashes. The usual price they sell for is less than 1s. per cart-load.

The scarcity and great price of firewood has caused the great increase in the use of cattle dung as fuel. The ordinary price of firewood is 16s. per ton, and about three and a-half tons are needed to produce the effect in raising steam of one ton of coals, the usual selling price of which is from £2 10s. to £3 per ton. With fuel at such high prices, steam cannot be employed except on railways. The great increase in the price of firewood —nearly doubled in the last twenty-five years— must be attributed partly to its great consumption on railways, the diminution of the area growing scrub jungle, and the greater demand for fuel for domestic use. Natives use a good deal of firewood; an average consumption is 40 lbs. per head monthly.

There are many kinds of fruit trees and shrubs that may be readily grown, either as hedges— greatly needed over the country generally—or in small plantations, for which there is plenty of land available without lessening the food-producing area. Measures should, I think, be taken to enforce the planting of a certain number of trees for each acre of a holding; the advantages would be great in improving the climate, affording shelter to stock from the fierce sun, and from the chilling winds that occur during "the rains," and fuel would be afforded for use in the home of the ryot, thus setting free the cattle-dung for its legitimate use. No expense need be incurred in growing the trees; the expenditure of a little labour is all that would be needed, and this at the season of the year when there is but little field-work that demands attention. If India is poor as regards money, she is rich in an abundancy of labour, and it is this, properly applied, that is needed so greatly for the development of her resources.

At present, not 5 per cent. of the arable land under notice is adequately manured. Under good management there would be no difficulty in increasing the manured area to 20 per cent. of the whole, were the manure available all used as such. How much less precarious the crops would be on well-tilled, adequately manured land, in the fierce heat of the South Indian climate.

The cropping of the land is very exhausting; not so much from the crops grown being those that make great demands on the soils, but because nearly the whole are removed from the farm. Of the occupied unirrigated area—which, in a good season, averages about twenty-four million acres—about five million acres are usually lying bare. This land is classed as bare fallow, but, as it receives no tillage whatever while thus unutilised, it is erroneously classed. That it benefits from the rest from cropping there cannot, however, be a doubt. The usual cropping of the land is:—

	Per Cent.
Grain crops	75
Pulse crops	10
Fibre, dye, oil crops, &c.	13
Garden crops	2
	100

As a general rule, no sort of fodder crops are raised by the ryot for feeding the farm stock; he grows only crops that his family need and that can be sold. There is no country better off than South India as regards the possession of good easily produced fodder crops, yet the ryot cannot be induced to cultivate them for use as such; he deems it to be the greatest folly to grow crops for the use of farm stock. The land is thus continually under what farmers term exhaustive crops. The straw of the grain and pulse crops is about the only portion of the field produce that is eaten by the stock, and that contributes to the enrichment of the manure heap. Under good management, a large proportion of the refuse matter of the produce raised should find its way back to the land, especially in the case of fibre, dye, or oil, producing crops, the valuable portions of which are of but little bulk, and do not take away much that the soil needs.

The unirrigated cropping area, to which only I am, at present, referring, may be divided as follows:—

	Per Cent.
Exhaustive crops	75
Restorative crops	4
Waste (called fallow)	21
	100

In Great Britain the cropping area is divided as follows:—

	Per Cent.
Exhaustive crops	55
Restorative crops	42
Fallow	3
	100

And Great Britain possesses, in addition, vast areas of permanent pasture, to which, in South India, there is nothing of a corresponding kind.

Had time permitted, I should have liked to have directed your attention to the different crops raised on the non-irrigated land, but I must content myself in simply offering a few general remarks on their character. The grains generally are very inferior; indeed, in this country, they would scarcely be bought by the farmer for feeding his stock. *Sorghum vulgare*, *Penicillaria spicata*, *Eleusine cavacana*, and *Panicum miliaceum* are the principal. On the average, these crops do not yield over 700 lb. of grain per acre. The pulses are not much superior; indeed, an eminent authority in this country, to whom average samples were submitted, expressed his opinion that some of them were little better than the seed of weeds. The low quality of Madras cotton is well known; the average yield per acre is only 70 lb., against an average of 250 lb. per acre, of a much superior quality, in America. In the production of dye and fibre crops, somewhat better results are obtained. With the exception of tea, coffee, and cinchona grown under European supervision, nearly all the produce of the dry land exported from South India commands but a low price in European markets.

The ryot knows nothing about rotation in cropping. In cropping his land, he sometimes manages that different kinds of crops follow each other, but this is for none of the reasons which, in this country, influence the farmer in adopting rotations. Usually, a piece of land is cropped again and again with the same kind of crop.

The practice of sowing three or four different kinds of crops together is very common. The object is to secure one crop, if possible, should the others fail. The ryot has learnt, from sad experience, how uncertain his sowings are. It is no unusual experience, in South India, to have to sow

the land twice or thrice for a crop. The objection to mixed crops is the difficulty experienced in weeding the ground while they are growing, and the impossibility of separating thoroughly the pulses, or different kinds of grain, when the crops are harvested and thrashed together. An attempt is sometimes made to harvest the crops separately, but this is very tedious, and occupies much time.

During the past half century, the State has repeatedly made attempts to effect some improvements in the produce of the unirrigated lands, by introducing from other countries, and distributing amongst the ryots, seeds of improved varieties of the crops usually grown. Towards the improvement of cotton great efforts have been made; but the results have been far from satisfactory, for many reasons, but chiefly because the State authorities made the great mistake of confining attention exclusively to cotton culture. Had the endeavours been directed towards the improvement of agriculture generally, any good result that arose would have acted on the cultivation of cotton as well as on that of other crops, and, the improvement being general, would have proved more lasting in its effects. It was a mistake to expect that the ryot could, on his shallow-tilled, starved land, cultivate with success the superior kinds of cotton produced in the deep, rich alluvial soil of Egypt, or on the virgin and more highly cultivated land of the Southern States of America.

The fact is, a high-class plant needs favourable conditions for its perfect development. The much-needed improvement in the field-produce of South India can be hoped for only as a result of improved husbandry. With a gradual improvement in the agricultural practice of the ryot, we may expect a gradual improvement in the character and yield of the crop he raises, not otherwise. The distribution of good seed to the ryots will, of course, be attended with some benefit, chiefly by the crops raised from it inter-breeding with those around of the same kind, and thus effecting some improvement in them.

The Farming of the Irrigated Land.

The entire Presidency contains about 5½ million acres of irrigated land; of this, about four million acres is held under the ryotwari and inam tenures, and it is to this land that my remarks will refer.

We possess a few large rivers in South India, but, as I have already noticed, they mainly depend on the rains, and decrease greatly in size in the hot season. In other parts of India, many of the irrigation rivers depend chiefly on water that results from the gradual melting of the perennial snows of the higher mountain ranges, and such rivers are not much influenced by the character of the seasons.

How to conserve and utilise the rainfall is the great problem to be solved in South India. I have already pointed out that we have, in most of the districts, an average annual rainfall of over 35 inches, and I have directed your attention to the fact that, while the greater part of the rainfall is usually precipitated in a period of about two months' duration, the crops are growing on the land, frequently exposed to a hot, scorching sun during from four to five months. I have also endeavoured to show how native farming makes the cultivated soils more dependent on water supplied by irrigation than they would be if properly farmed.

The principal famines in Madras during the present century were caused chiefly by the failure of the rains, and the consequent loss of the crops. These were in 1811, 1824, 1833, 1854, 1866, and that of 1876-77; and the last was the most severe of all, though the irrigable area is larger now than ever it was.

In Madras the land is irrigated from rivers, tanks, and wells. Rivers irrigate much the largest area. When the water of a river is needed for irrigating land, a dam is constructed across its bed, in a place where the water can be accumulated about the dam to a height that will admit of its flowing away, through distributing channels and drains, to the land where it is required. Most of the rivers rise on the hills, and, their beds sloping gradually to the coast, facilities are afforded for raising the level of the water by means of these dams. The most favourable position for the channel conveying the water from a river is along the top of a ridge of country with a gradual fall, and sloping on either side. Some of these channels are of a great size, and extend many miles over the country. Some are used for navigation; but they cannot, as a rule, be employed advantageously for this purpose, as they usually contain so little water at the season of the year when field produce is sent away to market.

River water is generally delivered on the land by force of gravitation; usually, it is only necessary to open a sluice to procure the supply needed. The ease with which the water can be obtained, and the absence of any regulation to prevent its too free use, results in a great waste of this valuable producing agent. In the production of a crop of paddy it is far from unusual to use a quantity of water equal to a depth of 12 feet over the whole of the area under crop. This is, at the least, twice as much as is required. Experiments have conclusively shown that, when the land is properly tilled and manured, a depth of water from 4 feet to 6 feet over the area cropped is quite enough.

Of course, when the water contains silt, as that of rivers generally does, the more water there is poured over the land the more silt there is deposited on it. But then, seeing that water is so necessary for raising crops in South India, and is available to such a small per-centage of the cultivated area, it cannot be right that the State should permit the lavish use of water, merely that the tenants using it may have the further advantage of not being under any necessity to manure their irrigated land; or, if the State must supply both water and manure to its tenants, then it certainly should demand payment for both. But I venture to think that it would greatly conduce to the welfare of the country if the ryots were restricted in the amount of water they used. If this were done, the irrigable area mightbe largely increased.

The lavish use of water in irrigating the land does a great amount of injury to public health, from the swampy condition to which much of the land is reduced, while the soil is rendered fit only for growing aquatic plants, such as the rice plant. The irrigated land, laid out in terraces, and resting on subsoils of alluvial sand, possessing good natural drainage, is not so liable to be

damaged by flooding as land not possessing these advantages, for the ryot never provides any drainage for the escape of the surplus water. He conducts his irrigation operations as if he thought the whole object to be gained was the retention of the water on the land, rather than to secure its passage into and through the soil.

It is by economising the water now available, and thus bringing a larger area of country under the influence of irrigation, that the most good can be achieved at once. Of course, the extension of irrigation—by developing and extending the systems in operation, or by establishing others—is also necessary.

It is true that much of the expenditure by the State in later years on irrigation works has not resulted in much direct profit, but I believe that there is no improvement which will confer a greater benefit on the country generally than the extension of irrigation systems wisely planned. But the State authorities, in carrying out such enterprises should remember that the agricultural as well as the engineering aspects of the projects submitted for approval need careful consideration; to the neglect of the agricultural aspects of many of these projects, must, I think, be attributed much of the failure that has resulted to many. The only crop produced on the land irrigated from rivers is the rice crop. Its cultivation is very simple. After the crop is established, by sowing or planting, the only attention the land receives is regular flooding and an occasional weeding.

In many parts of Madras, considerable areas of land are irrigated from tanks. Some of these tanks are of a great size, some many square miles in area. Tanks are not excavations; they are generally formed by raising an embankment across the drainage-line of a country, and running the banks up the slope on either side. A tank is generally so placed that, while it has a sufficiently large drainage-collecting area above it, there is, at the same time, a sufficient area of suitable land on a lower level, upon which the stored water will flow without being lifted. Sometimes, tanks are fed with the surplus water of rivers, but this is not usual. Many of the smaller tanks are in natural hollows or basins, and when this is the case the water must be lifted to a height sufficient to enable it to flow to and upon the land to be watered.

Tanks are of use in storing the surplus rain-water that falls during the wet season for use in the dry weather. Generally, however, tanks are not nearly of the use they might be from the absence of any regulations for the proper use of the water, the consequence being that each cultivator having the right uses it lavishly, and the store is exhausted by the time the water is specially needed. There is little excuse for the lavish use of the water, for it contains little or no silt. Some tanks are so very shallow, they lose, by evaporation, a great deal of the water they collect. Shallow tanks are also very objectionable because they cover so much ground. It not unfrequently happens that the area occupied by the tank is greater than the area irrigated by its water. Land irrigated from tanks is usually cropped with the rice crop.

In some of the districts there are great numbers of wells, the water of which is used for irrigating land; but, as these wells are seldom less than 20 feet deep, the cost of lifting the water reduces largely the returns from the crops. Yet, as a means of supporting the people and the farm stock in adverse seasons, these irrigation wells are of very great value. The wells are usually sunk at the expense of the ryots. When land is provided with a well, it becomes much more valuable. The soil is maintained in a good condition by the frequent application of manure, or by folding sheep. If the other land of the Presidency was as well formed as that watered from wells, there would be but little to complain of in native farming. Not only is the soil better managed, but its irrigation is performed in a far more satisfactory manner. A given quantity of water will be made to produce three times the useful effect, when raised from wells, that the same quantity of water obtained by opening a sluice usually produces. The fact is that, when he has the trouble and expense of raising the water 20 or 30 feet, the ryot fully appreciates its value, and applies it with care. If only the ryot could be induced, or compelled, to use with the same care the water delivered by channels on his land, how great would be the benefit to the country.

The uncertainty attending the sinking of wells greatly lessens enterprise in this direction. If there was greater certainty in securing good results, many more ryots would sink wells in their holdings. This matter is now receiving attention from the proper authorities. It has been proposed to employ a staff of men in boring for water in suitable places, where wells are required.

An average-sized well will cost from £25 to £30, and but few will afford water for more than five acres of land. The annual interest, therefore, at the usual rate (10 per cent.), on the outlay, would represent a charge of from 10s. to 12s. per acre, a sum considerably in excess of that charged by the State for water delivered on the land and supplied without limit. For raising the water from an ordinary well, the cost per acre for each irrigation given is not less than from 1s. 6d. to 2s. 6d., frequently more. Hence, wells cannot compete with the State irrigation works in the supply of water for irrigation use. They are, however, of great value in times of scarcity produced by drought, for they frequently afford water long after the other sources of irrigation water have dried up, and at such times the price at which the water is obtained is not a matter of so much consideration.

The crops usually grown on land irrigated from wells are tobacco, chillies, plantains, wheat, &c. The last-mentioned crop is grown to a very limited extent; of over 24 million acres under crop, the wheat crop does not occupy 30,000 acres, and this is chiefly wheat of inferior kind, chiefly spelt. Under an improved system of farming, there are large tracts of country in the northern part of the Presidency well suited for growing ordinary wheat. Tobacco is largely cultivated, but it is grown with so little skill, and is so badly cured, that it cannot find a market in Europe. There are considerable areas of land on which good tobacco might be grown. The results of many analyses of the tobacco of South India show that the ashes of these tobaccos seldom contain more than 5 or 6 per cent. of carbonate of potash, while the ashes of American tobacco contain from 20 to 40 per cent., proving

the poverty of Indian tobacco soils in this important plant-food—a plant-food, however, easily obtainable in the shape of saltpetre, and at a moderate cost. But, though saltpetre is largely exported from the tobacco-growing districts, it is never employed as a manure for tobacco.

I must reluctantly bring my observations to a close; there are many other subjects which I would like to bring under your notice, and I could have wished to have referred more fully to many that I have brought before you, but time will not permit. I have endeavoured to point out some of the difficulties under which agriculture is practised, and have indicated some of those that appear capable of removal, or of such modification as would, in my opinion, render them less injurious in their action. I have dwelt very fully on the shortcomings of native agriculture; it would have been a far more pleasing duty to have pointed out some of its good points—for there are some—but the demand for reform is far too urgent to allow of time and opportunity being employed in any other way than in an endeavour to aid in getting these reforms instituted.

DISCUSSION.

The Chairman said everyone who was interested in India must be very much indebted to Mr. Robertson for his very suggestive paper. He said suggestive, advisedly, for he was prepared to traverse several points in it, not as a Government servant, but in the interest of truth. So far as the professional part of the paper was concerned, it was admirable, and the statements as to the want of manure and the poor character of the agriculture were perfectly true. The parts to which he took exception were the general remarks. One great question was, whether after all allowances had been made, there was not some progress going on; some substantial increase in the progress of the country. He had prepared, through the kindness of some of the officials in the India-office, a statement, showing the state of agriculture during the last 25 years, and he would not go back farther than that, though his own memory went back far beyond that, to a time when they could scarcely keep the land in cultivation; when prices were far below the commutation prices at which the land revenue was taken, and when other distressing features existed, which led the Government to consider whether a large reduction in the revenue demand should not take place. Within the last 25 years, however, circumstances had vastly changed; prices had assumed a different character, and were now nearly twice, and in some cases three or four times, what they were. That, of course, removed the necessity for dealing with the land-tax, which was a heavy burden on the agricultural classes, and which had more to do with the backward state of agriculture than many persons would believe. This statement of the agricultural condition of India for 25 years, really only described the state of things over about four-fifths of the cultivation, because that was the part to which the *ryotwari* settlement applied. He used the word settlement rather than tenure, advisedly, because it simply meant the valuation for revenue purposes, and not a title to the land. The statement extended over 1852-3 to 1877-8. Within that period of 25 years the whole area of cultivation had risen. The entire area was about 88,000,000 acres, and of that area under the two revenue settlements about 25,000,000 to 30,000,000 were under cultivation, which of course left a very large margin uncultivated. Within that margin there was the vast area of mountainous land, and a great deal of dry, arid plain, which would not, within any time they could contemplate, come under cultivation, but still there would be a large margin yet to be brought under cultivation. Within those 25 years, the rise in the *ryotwari* cultivation had been from 12,000,000 to 20,000,000 of acres. Taking the first four years and the last four years of the series, there was a difference, therefore, of upwards of 70 per cent. increase of cultivation under the *ryotwari* holdings; 80 per cent. of this increase was in what was called the dry or unirrigated land, which was by far the most important, because on this dry land were grown the whole of the dry grains which formed the staple food of the people, especially of the poor. Rice was never seen in a poor man's house, the food of the poor being dry grain. The cultivation of those soils was inexpensive, and on them were raised all those important raw products which were of commercial value, and went to enrich the people, such as cotton, oil-seeds, wheat, tobacco, cocoa-nut, spice, coffee, tea, and the like. Now, an advance of 80 per cent. in 25 years is really a very substantial addition to the wealth and prosperity of the country. Turning now to the irrigated land, he found that there had been a growth of 1,250,000 acres: it really was 1,500,000, because, under some peculiar management of the accounts, a good deal of the wet land was transferred under the head of dry land. For instance, all the land irrigated by the Godavery works was transferred under the heading of dry land, for there the water-tax was treated as a separate matter. The advance was thus probably something nearly double in the irrigated land, which, of course, represented a very large investment of capital, because the irrigated land was mostly in the hands of the better class of people; but the profits of this large area of increased cultivation were a large accession to the national wealth, so that on those two heads there were great advances, and great industry was manifested by the people in every way. He found by the accounts that, probably, now about double the area of wet land was producing two crops for the extra charge for water on the double-cropped land, which was £43,000 in 1855, was now nearly £100,000. It was very satisfactory also to see that the State had been doing its duty in this matter, for the revenue derived from the freshly-watered land had risen from 1855-6, when it was £64,000, until it was now £336,000, and, bearing in mind that two years of famine had come into the last averages, he had no doubt when the effects of those years had passed away it would be from £350,000 to £400,000. But while the State had derived its reward, probably, to the extent of nearly £400,000, the people had benefited much more largely, for a man who paid a water-tax of £1, certainly obtained a profit of £2 upon it. So that there was a very substantial growth of wealth and comfort amongst the people from that source also. On the whole, therefore, there was general advance of agricultural prosperity in South India. He was glad that Mr. Robertson had confined himself to South India, because it enabled them to deal with definite statistics. One great difficulty in dealing with India was its great extent. There were really 11 or 12 provinces which might be fairly called States in the American sense, and one easily got lost amongst those different States and their different conditions. Now, as to the tenure of land and the land-tax. He must traverse the impression which Mr. Robertson had raised. The land-tax in India was a very heavy demand, for it swept away pretty nearly one-third or one-half of the rent-roll of the country for Imperial purposes. If any large portion of the rent-roll of England were abstracted in taxation, it would be found that there was a good deal of reason why the labourers' cottages were not so good as they might be; and probably it would not be found that the Duke of Sutherland would have improved his property to the extent he had if from one-half to one-third if his rent-roll were taken in taxation. The land-tax was a heavy charge, but this statement showed there had been

really a very sensible decrease in it, for he found that the average acreable rate of the land-tax upon all dry land in South India had fallen from about 3s. (1852-3) to 2s. 2d. now, which was a very substantial reduction. To a certain extent, no doubt, it was due to inferior land coming under cultivation; but even making allowance for that, there was a substantial reduction in the demand. The assessment upon the wet land also showed a decrease. The average assessment in 1852-3 was 14s. an acre, and it had steadily decreased until it was down to 9s. an acre. That was a substantial reduction, but he admitted these accounts rather overstated it, and probably the average tax should be taken at 10s. On the whole, therefore, there had been a reduction of the land-tax on all land. He wished the meeting to believe, as he did most heartily himself, that the agricultural population of India were, at this moment—despite fiscal burdens which were unknown in this country, despite occasional scarcities and even dire famines, despite all the disadvantages which Mr. Robertson had so justly drawn attention to, and others which might be mentioned—adding to that illustrious record which had reflected the highest honour on our beloved country, and on the reign of her Majesty, the Queen-Empress of India. He wished them to remember that, when dealing with Indian matters, they should do so with justice to the people, with wisdom and with sympathy; the Indians wanted nothing else. Now, he must add that anything going out to India from Mr. Robertson would tell very seriously; and there were two points about which his errors would cause much apprehension. One was the tenure of land in India, which, as had been said, was the most important question, if they wished to encourage agricultural improvement; the other was the land-tax. As to the first, what was the degree of certainty of title to property in the soil in India? He could only say that, as he read Mr. Robertson's paper, it conveyed to his mind the idea that he holds, that they had in India a lot of leasehold tenants, and not proprietors of land. Now, there was no such thing as serfdom in India; there was no such thing as holding land of the Government; or, if there was, it was of very late creation. The men did not pay rent. He stated this very firmly and plainly, because he wanted it traversed, if possible. The soil of India was the property of the people. It belonged to its landholders, and the landowners of India were not the State, but the Indians. In this respect they had the best guarantee for the improvement of the land. He need scarcely say that there was no such thing as this change of land, of which Mr. Robertson has spoken, nothing was more stable than its tenure; for there was the intensest love of land on the part of their Indian fellow-subjects, and a love of the scene of their own labours. It was proverbial. It was an instinct which could not be extinguished—a love which survived the very bitterest discouragement. The land of India was private property in the fullest usufructory sense of the term. All those rights which were exercised in England by owners and landlords, were equally exercised in India by owners and landlords; the rights of property were, for all purposes, essentially the same, whether the landowner were the proprietor of one of the great estates technically termed the permanently-settled *zemindari*, or the peasant-proprietor of a few acres, which might be valued for the purpose of the land-tax, under the less assured conditions of what they called the *ryotwari* settlement. The title was as good, whether it was derived from ancient hereditary prescription, or from the usufructory occupation of a few years. The value of this condition, which was found existing in India, had been appreciated by the Government from the earliest years of our rule, and all our revenue arrangements had been from the first directed to strengthen and comfort these ancient prescriptions, and to create proprietary rights where their previous existence might be less conclusively obvious. The *zemindari* settlements were made with the old proprietary nobility of the country, and they had for their aim to confirm the proprietary right. He would not enter on the mistakes which were made in *zemindari* settlement, for he was merely talking of the principle. The *ryotwari*, or individual settlements, were exactly the same; they simply ratified the existing condition of property as it was found. For instance, the *ryotwari* settlement of Canara merely ratified the ancient native settlements of the 15th century. So it was with the native settlement of Malabar, made with Tippoo in 1784, and accepted by the British rule in 1792. Such also were the settlements with the individual owners of the communal property of the rural villages of the Deccan. These settlements really confirmed the property, recognised it, and in every way comforted those rights which made an agricultural population contented and industrious. He wished to repeat it; the people, and not the State, are the landlords of India. Landed property of all kinds passed without any intervention of the State, by inheritance, purchase, sale, or any other device. It was partable amongst members of the family without the interference of the State, and became subject to mortgage, lease, &c., and could be dealt with, for all practical purposes, as ordinary freehold property in this country, whether the owner were a *zemindari* or a *ryot*. Any land needed for public purposes must be purchased by the State from the *ryot*. If they followed that landholder to his farm, what did they find? However small his property, they found him in perfect freedom as to the process of his cultivation, and the rotation of crops he might adopt. There was no interference, no dictation in any way on the part of the tax-gatherer. He could not even be required to avail himself of water when placed by the State within his reach for the irrigation of the land, if he could not see his way to doing so. If misfortune or bankruptcy overtook him, for all practical purposes, the State was simply a first creditor against all his property, personal and real. If the land-tax was unpaid, the tax-gatherer could not enter on the land or summarily oust him. The ownership, in fact, could not be transferred, except by public sale, and after that public sale, every penny realised must be accounted for to the bankrupt. Those were not the conditions of tenantry, they were good solid incidents of property, and gave exactly the guarantee for the advancement of agricultural prosperity, which was required. Not only so, but there was provided for the proprietor, whatever he was, a very efficient and complete rent law, which enabled him to recover his dues without any intervention of the State, which otherwise regulated the relations of the proprietor and his tenantry, and the State could not use that landlord and tenant law for its own purposes, but had a separate law for the purpose of collecting the land-tax. He feared he had treated this at too great length, but the fact was there was a great deal of misapprehension on the subject. To use such a term as *ryotwari* tenure was much the same as if it were said that you hold property in London by your water-rate bill. That was not the place to discuss all these matters, but it would answer his purpose if the facts he had endeavoured to lay before the meeting showed that the people of the country were the landowners and landlords of South India, that their titles were reliable, and were confidently trusted in by the agricultural community, and that the Government had never attempted to confiscate the rights of property, or failed to recognise the facts as they found them, and to comfort those conditions in their arrangements for the assessment and collection of the land-tax. Now, as to the land-tax, he would say a word or two. It had been spoken of as rent, but it was not so. The greatest financier who ever went to India, Mr. James Wilson, said, in his budget speech in 1860, "I have consulted the ancient sacred authority of Menu and the version of the ancient Hindoo law.

Upon the best authority at my disposal, it was as follows:—'The revenue (says the writer) consists of a share of the grain, and of all agricultural produce. The rates of taxation are as follows:—For cattle added each year to the capital stock it was one-fiftieth, which, in time of invasion, may be increased to one-twentieth. On grain, one-twelfth, one-eighth, or one-sixth, according to the soil and the labour necessary to cultivate it; but this may also be raised, in case of emergency, even to as far as one-fourth." Such was the prescriptive common law of the country. Mr. Wilson, after reviewing the other sources of Indian taxation, exclaimed, addressing the Viceroy, "I must say there is latitude enough here for the most greedy exchequer and most voracious Minister." But greedy exchequers and voracious Ministers had been at work on the landed income of the country long before Mr. Wilson had anything to do with it. The prescriptive limit (even for perilous times), which was 25 per cent., had been exceeded long before the provinces of South India came under British rule, and our early settlement officers found the State demand against the agriculture of the country no longer one-twelfth, or even one-fourth, but practically based on one-half of the gross crop, taken part in kind and part commuted into cash. We had inherited a grave transgression, and had never been able to concede any substantial relief. At this moment we were revising the revenue demand against the great bulk of the landed property, on the basis of exacting for fiscal purposes what might be roughly call one-half the nett average income. A demand of that kind was a very serious matter. However, it was carried out with every consideration, and probably the final demand scarcely ever equalled the theory of the settlement. Still, every acre of land bore a searching and heavy fiscal burden, and, under such circumstances, of course, the accumulation of agricultural capital was very slow, and, naturally, progress had been somewhat laggard. He was not discussing the principle of the land-tax as a source of revenue, much less impugning its incidence, or even pleading for a mitigation of its burdens. These matters belonged to a separate discussion. He would merely remind the audience that, when disparaging the condition of Indian agriculture, and regretting its slow development, they must bear in mind that it really bore burdens which diverted to martial and other purposes a very large proportion of the income which probably, in this country, fructified around us in the blessing of a lively agricultural prosperity.

Colonel Rathbone said, as the Chairman desired someone to traverse his statements with regard to the ryotwari tenure, he should be happy to do so. There was no doubt that, under the old native tenure, the rate that was taken was exactly one-sixth of the current crop; but we had introduced another system altogether. The ryotwari system had been explained to them as being exactly the same as property in England, and that it had all the incidents of proprietorship; but, in point of fact, instead of that being the case, Mr. Robertson had explained a little before that the ryot's position was this, that he was to be assessed by the collector or his deputies, at whatever sum they chose to fix, they being often ignorant of the matter; but if the unfortunate ryot did not pay the rent thus fixed upon him, he could have his property seized; if that was not sufficient, he was put in gaol; but even that did not cancel the debt. If such a system as that was called the same as that of freehold property in England, it seemed to him a very extraordinary application of language. To say that a man, who was in a worse condition than an Irish peasant, who could be taxed in that way, as he had often known to be the case, was in the same position as an English freeholder, seemed a perversion of terms; at any rate, it was a mistaken use of them. He need only refer to the Acts passed in Bombay when he was there.

The Chairman reminded the speaker that the discussion was strictly confined to Madras.

Colonel Rathbone said the ryotwari system in Madras was the same as in Bombay, and the Government generally applied the laws of one province to another. He had no doubt that further research would show that the same thing existed in Madras. Those Acts of the Legislature distinctly provided that the collector or assessor could fix what rate he pleased upon the different holdings, and the man who did not accept those terms might be turned out, and the Government assumed to itself the right and property in their land for ever. Those were the provisions found in the Acts passed in Bombay, and he had no doubt the same thing occurred in Madras. Then it was further said that the incidents of proprietorship were present, that these men had the same rights as the landlord in England. It was not two years ago since a long discussion took place at the East India Association on the subject of the proceedings of the Government with regard to cutting the jungle. In England the commoner had a right of grazing, and could cut brushwood and so on, and it used to be the same in India. Every villager had a right to their own grass, and to cut their own jungle, but this was now put an end to, showing that all idea of there being any proprietary rights was an entire mistake. They had a right to occupy their land as long as they could, until a higher assessment was put upon it; but how large that might go was proved by an Act passed by the Government of Bombay, that in future revisions, not more than 100 per cent., should be added to the existing rate. It was proved, in Bombay, that 180 per cent. was actually added in some cases; therefore, to say that people under such conditions were in the same position as proprietors in England, was a perfect mistake. Until the Government did really give fixity of tenure, or something equivalent to it, it was no doubt the Indian ryots would be the impoverished race they unfortunately were.

Sir Charles Trevelyan said it was rather too late to begin a discussion on the Indian land revenue, and, perhaps, it would be well to confine themselves to a simple acknowledgement of the great ability and value of the paper. He agreed with the Chairman, that as regards the feelings of the ryots, they were land owners; they loved their land, and compared their tenure of it to grass with deep roots, which could only be removed with the greatest difficulty from the soil. He also agreed that the demand of the Government upon the soil had been very much diminished. Although Lord Harris's Government reductions were going on all over the country, and the condition of the people had, no doubt, improved; the real obstacle to the improvement of the country was not the amount of the assessment, but its uncertainty. So long as it depended on the comparison of the qualities of the soil made by persons with limited experience or fallible judgment, or by haphazard calculation of the net profits, there must be uncertainty, and a real feeling of ownership and growth of confidence, such as would lead to the investment of capital in the land, could not arise. In the Tanjore district this had been attained in a considerable degree, owing to the exceptionally favourable circumstances, and the consequence was that there was a set of really well-to-do yeomanry, and the famine fell very lightly there. Mr. Robertson pointed out that many civilians went to India without any instruction in agriculture, and certainly if they could go through a short course of lectures such as they had heard that evening it would be of the greatest benefit to them, not only for the information they would derive, but from having their attention directed to an important branch of their future duties. Sir Charles Trevelyan concluded with a warm tribute to the abilities of the Chairman.

Mr. Ackilandaiya said it had given him very great

pleasure to hear so able a paper from a gentleman so intimately acquainted with Indian agriculture, and consequently eminently fitted to pronounce an authoritative opinion on the subject. They had also the advantage of being presided over by a gentleman, the best part of whose life had been spent in the service of this country in Southern India, and who, in the course of a long and distinguished public career, had many opportunities of considering this subject in all its phases, and coming to a correct conclusion upon it. The subject of agriculture was very important in connection with any country; but with India, which was essentially an agricultural country, it assumed the most vital importance. As it was getting late, he would only say a word or two on the subject of the zemindars. The tenantry, directly under the control of the British Government, had been styled the ryotwari tenure, and they considered that they had a permanent proprietary right under that tenure; but in those tracts which were subject to the zemindars, or large landed proprietors, there were a variety of tenures, and it would be a very great advantage if some uniformity could be introduced there. The rates of assessment which the ryots paid the zemindars, were sometimes four or five times as much as their neighbours paid to the Government, although subject to the same conditions, and cultivating the same sort of soil. Why there there should be this difference, it would be difficult to understand. He believed the evil could only be removed by Government interference, and if one wished to see fairness and justice all round, the sooner the matter was taken up the better it would be.

Dr. Voelcker said he could not deny himself the gratification of moving a vote of thanks to Mr. Robertson, and he did so with the greatest pleasure, because he very well remembered the time when that gentleman was one of the best pupils in his laboratory, and it only showed what you could make of a chemist. There were many, even in this country, who looked with suspicion on scientific farming, but he thought Mr. Robertson had done good service, and they had the assurance of the Chairman that he had done so; and that he would do so still more, he was fully persuaded, because he knew there was a great amount of latent energy in him. He was delighted to hear that it was the intention of the Government to extend the experimental farms. He also hoped that means would be taken to afford civilians, who went out to India, an opportunity of qualifying themselves on this subject. Quite recently he had been in communication with the principal of the college at Cirencester, and he was going to impress upon him the desirability of instituting a special course of lectures for men who might be intending to go out to the colonies, and especially to India, because he knew, from his own experience in the coffee plantation of Malabar, where he was one of the first to introduce experiments some 30 years ago, how much could be done to improve Indian agriculture. He hoped they would have another paper showing more in detail how improvements could be made, and on that occasion he hoped they would have a good agricultural discussion.

Mr. William Botly seconded the vote of thanks.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 12th, 1880; Lord Alfred S. Churchill, Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Cawley, George, 191, Malpas-road, New-cross, S.E.
Jäger, J. G., Rokin, Amsterdam.
Pennington, Nathan Glossop, Park-house, Gloucester-gate, Regent's-park, N.W.
Setton, Ernest W., 24, Abingdon-villas, Kensington, W.
Showers, Major-General, Travellers' Club, Pall-mall, S.W.
Sillar, William Cameron, St. James's-lodge, Kidbrooke-park-road, Blackheath, S.E.
Westwood, Joseph, jun., The Lake, Snaresbrook, Essex.

The following candidates were balloted for and duly elected members of the Society:—

Alcock, Sir Rutherford, K.C.B., F.R.G.S., 14, Great Queen-street, Westminster, S.W.
Ashburnham, The Earl of, Ashburnham-place, Battle Sussex.
Bartholomew, Hugh, Glenorchard, Torrance of Campsie, N.B.
Bourne, Craven, 2, Frith-street, Soho-square, W., and Craven-house, Beaconsfield-road, New Southgate, N.
Foskett, William John, 9, Fenchurch-street, E.C.
Grist, Samuel, 153, Adelaide-road, N.W.
Haxell, Edward Nelson, Lewgars, Kingsbury, Middlesex.
Haysman, James, Burgess-hill, Finchley-road, N.
Little, Christopher James, 17, Groombridge-road, South Hackney, E.
Romney, The Earl of, Gayton-hall, King's Lynn, Norfolk.
Shaftesbury, The Earl of, K.G., 24, Grosvenor-sq., W.
Thomson, Sir William, LL.D., F.R.S., The University, Glasgow.

The paper read was—

UTILISATION AND PROPERTIES OF BLAST FURNACE SLAG.

By Charles Wood.

The disposal of the enormous output of slag or scoria from blast furnaces has always been one of the serious difficulties of the iron trade. Taking an average of all the districts in England, for each ton of iron made, 25 cwt. of slag is produced, and from the official returns of last year of the iron smelted, no less than 8,000,000 tons of slag were produced. The space occupied by this mass, when loosely tipped, is something like 170,000,000 of cubic feet, or nearly twice the size of the Great Pyramid, whilst the bulk of the iron occupies only one-sixth of the same space.

There, is, however, this great difference between iron and its refuse, that, whilst the former is diffused, and finds its way into every corner of the world—from the hook at the end of the fisherman's line, or the hair-spring of a watch—from the magnificent steam-ship, or the abundant works upon the various railways, to the splendid roof of many of our public buildings, or the small but infinitely long rod of the telegraph wire—whilst iron has been diffused through all these beautiful branches of the arts and sciences, its companion slag has been left behind at the smelting works, a hideous memorial defacing the landscape, absorbing something like a quarter of a million sterling annually in its disposal, and destroying for ever hundreds of acres of valuable agricultural land, forming, as it were, a blot upon the face of the earth; and left as a land-mark to show where this wonderful metal, iron, has been extracted, the development of which has contributed so much to bring the world to its present state of civilisation.

That this state of things will entirely cease, the author does not, for one moment, think possible. So long as we produce such enorm-

ous quantities of iron, so long will these heaps go on accumulating. And there is little chance that these existing masses will ever be turned into a marketable product. At the same time, there can be little doubt that blast furnace slag possesses many valuable properties, which may, in certain localities, be converted into things useful to the arts and sciences, and—which is a most important point—at considerable profit.

There are other slags produced in many metallurgical operations—such as in the smelting of copper, lead, zinc, and tin ores—of which no use is made; but there are also slags, or cinders, produced in the manufacture of wrought iron, some of which are re-smelted, after which no great bulk of refuse is left. Nor is there, in the author's knowledge, any use whatever made of this residue.

Blast furnace slag, as it flows from the furnace when making foundry iron, is usually of a grey colour, of much the same consistency as molten glass, a substance, in many points, it greatly resembles, particularly when the more siliceous ores are being smelted. It is very fluid, and has a temperature considerably above the melting-point of cast iron; in proof of which, if a piece of cold cast iron be placed in a block, or wagon of fresh molten slag, it readily melts. At this high temperature, it contains a large quantity of gas, a considerable portion of which is thrown off or exuded as the slag cools down or becomes set. So much is this the case, that a large block or ball, technically so termed, will often burst, an hour or two after being run, from the accumulation of this gas in the inside. The bursting of these balls at the ironworks is of constant occurrence, and a source of danger, caused by the liquid slag and the outside shell dropping after the ball has burst. This is partially overcome by making the workmen knock a hole through the top crust before leaving the furnaces. Again, the least derangement in working of the furnace is quite sufficient to alter the nature of the slag, and often, within half-an-hour, will the slag be changed from grey to a perfect black. Such a colour usually indicates imperfect smelting, and the slag will be found to contain a larger proportion of iron than it should do. Such, then, is the material with which blast furnace managers have to contend, and which forms their *bête noire*.

For many years the only known use for blast-furnace slag was for road-making, and for this purpose it is still largely employed. In Northamptonshire, and in certain districts of Yorkshire, the whole of the slag produced is sold at a considerable profit. These, however, are local exceptions. Perhaps the largest user of slag is Mr. John Fowler, M.Inst.C.E., engineer for the Tees Conservancy Commissioners, whose works upon the breakwater at the Tees mouth deserve to rank as some of the most interesting in the kingdom. On these constructions Mr. Fowler consumes something like half a million of tons annually. A similar class of work is also being carried on at Barrow-in-Furness, from the slag produced at the hematite furnaces in that town; but, in consequence of the large amount of lime contained in this slag, much greater care has to be taken in its selection. The slag used at the Tees Breakwater is chiefly taken away upon bogies, in blocks weighing three and a half tons each. The slag is run into these blocks, upon the wagons, at the furnaces; a case or box being placed upon the bogie for this purpose. When the slag is sufficiently "set," this case is removed, and the wagon, with the block upon it, is taken a distance of about six miles to the breakwater. A large quantity is also tipped upon a platform on the river side, in such a position that the tide completely covers it; it is then wheeled into hopper barges, belonging to and for the use of the River Tees Commissioners.

In consequence of the Tees Breakwater (known as the South Gare Breakwater) being now nearly completed, and the Tees Commissioners wishing to commence the breakwater on the opposite side of the river, called the "North Gare Breakwater," Mr. Fowler, in conjunction with the author, devised a plan for shipping the bogies with the hot balls into barges, and towing them down the river to a landing-stage constructed for discharging. Each barge is constructed to carry forty bogies, and will be about 220 tons burden. These barges will bring back the empty bogies on the return journey.

The loading of these barges at all states of the tide has naturally occupied a considerable amount of attention, and the machinery for shipment, designed by Messrs. Appleby Bros., of Southwark, and called a "Titan," has been recommended by Mr. Fowler, and generally adopted. Cantilevers, from a frame travelling on rails on the quay, overhang sufficiently to reach the outside of the slag barge, and a kind of overhead traveller runs backward and forward on these cantilevers, a distance of about 35 feet. The slag bogies are lifted and lowered by two steam-winches on the traveller, the centres of which correspond with the two lines of the rails upon the quay and upon the barge. A square shaft, running the whole length of the Titan, transmits all motions to the winches for lifting and travelling. Each winch has two drums for flat steel-wire rope, and these ropes are connected together by cross-beams, with slings for taking hold of each end of the bogies, the object being to prevent them from twisting when being lifted or lowered, and to ensure their coming directly upon the lines respectively on shore and in the barge.

The Titan is fitted with two lines of rails, one for full, and the other for empty bogies. As already indicated, these lines correspond with those on the barge.

The mode of working is as follows:—When a barge-load of empty bogies are brought alongside, the bogies on the first transverse line are landed, and the barge is warped forward until the line which has been cleared comes opposite to the line for the loaded bogies; the travelling winch then picks up a loaded bogie, traverses out with it, deposits it in the barge, at the same time picks up an empty bogie from the barge, then returns to the wharf, deposits it on the line for empties, and so on at each operation; so that the traveller takes out a loaded bogie, deposits it on the barge, and brings back an empty bogie each journey. The speeds of working are estimated to be equal to loading and discharging at the rate of 40 bogies per hour.

The engine, boiler, coal bunk, feed water tank, and counterweight box are fixed at the inshore end, and a platform on the traveller is provided

for the driver, so that he stands directly above his work, and can clearly see each operation. One lever gives the motions of lifting and lowering, and another lever those for travelling in either direction. The whole of the work is performed by two men on the Titan, a stoker and traveller man, two men being required below to attend to the slings.

The next stage in slag utilisation is the endeavour which has at various times been made of running the liquid slag, as it flows in a stream from the furnace, into moulds; or, in other words, making slag castings. Such an idea, at first sight, would seem natural enough. Here, it may be said, is a material flowing to waste, in a liquid state, capable of being run into moulds, and of taking impressions almost equal to that of cast-iron. The castings also, when successfully made, are exceedingly durable, and even beautiful to look at. So alluring has been the idea of casting, that, during the last fifty years, the Patent-office has recorded almost annually the attempts of some inventor impressed with the notion that he could treat this treacherous fluid successfully, or, in some way or other, make it useful in the arts. To attempt to describe these various schemes, or to give even an outline of them, would occupy far too much time, but the author thinks that the following remarks will give a general idea of the difficulties he has had to meet.

The high temperature at which the slag leaves the furnace has been before noticed—namely, about 3,000° Fahr.—but, when it is brought into contact with anything cold, in the shape of a mould, it readily parts with its heat, and, in so doing, suddenly contracts. The surface contracting becomes filled with fine cracks, or flaws; so much is this the case that, if allowed to become entirely consolidated in the moulds, these cracks will be found to penetrate completely through the casting, and, upon exposure to the air, the casting falls to pieces. This is the more vexing, as, when slag is run into a large mass—say into a pit of sand eight or ten feet deep, and containing from 30 to 40 tons—there is such an enormous amount of heat accumulated that it becomes self-annealing, the outside of the mass is kept at a high temperature, and, if allowed to remain until cool, not a flaw will be found, and the slag becomes so exceedingly tough and hard that it may be quarried in the same way as granite or Whinstone, and used for street-paving.

There is, however, one exception to the numerous failures in slag casting, it is known as Woodward's patent, and, although there is absolutely nothing new in the process, still, through the perseverance of Mr. Dobbs, the late manager and engineer for the furnaces of Messrs. T. Vaughan and Co., an amount of success has been arrived at sufficient to enable the company which works the process to pay a fair dividend. The success has been eminently a practical one, and appears to rest mainly upon two points—Firstly, in the quickness with which the castings are removed from the moulds and placed in the annealing ovens, where the temperature is constantly kept up nearly as high as the melting point of slag, the heat, after the ovens are full, being so gradually lowered that the outside of the casting cools at the same rate as the inside; the contraction is thus equalised throughout, strains upon the outside are avoided, and the fine surface cracks do not penetrate much below the skin. And secondly, upon the fact that only solid rectangular blocks, with a certain amount of bulk in them, are attempted.

On this wall is a diagram showing the apparatus and annealing ovens now in use at the works of the Tees Scoria Paving Block Company. The blocks are made by running the liquid slag into a series of open-topped moulds. The moulds are of cast iron, and are held by one end upon the periphery of a horizontal wheel or table. The wheel is suspended by tie-rods upon a central pillar. The moulds, when being filled up, are brought in succession under the slag-runner by the man in attendance, who watches until the mould is full. When the slag has become consolidated in the moulds a catch-hook, is knocked up, the mould falls to pieces, and the brick drops to the ground. When they come out of these moulds, although consolidated, they are still in a sort of half-molten state, and are immediately removed into annealing ovens, which are always kept at a high temperature, so that the block receives no chill—the ovens are of small size, and, when full, are sealed up and allowed to cool down by themselves. There are about 70 moulds upon each machine, and the hotter these are kept the better; whilst, to prevent chilling of the molten slag as it runs into the moulds, they receive a thick coating or washing of chalk or lime after each casting, the lime acting as a non-conductor as well as assisting the block more readily to drop out of the mould.

Thus it will be noticed that the casting is not allowed to remain in contact with anything which can extract its initial heat, so as to produce unequal cooling; and, as before stated, the whole success has been eminently a practical one, and reflects great credit upon those who have so patiently worked it out.

Large quantities of these bricks or paving blocks are used in the North of England for crossings, stables, yards, and streets; their durability, uniformity, and general appearance when well set is very pleasing. From a series of tests recently made, against a crushing strain, some of these blocks carried a weight equal to the hardest granite.

The next successful process for dealing with molten slag is that of Mr. Bashley Brittain's, who converts it, by a kind of compound process, into glass for bottle-making, and for many purposes where a pure white glass is not essential.

Sir Samuel Canning, Managing Director of Brittain's Glass Company, has kindly supplied the author with the following chief points of interest.

The slag is taken from the blast furnace in large ladles upon wheels, in quantities of about 500 lbs. In this state it can be conveyed a considerable distance to the glass-works, where it is poured into a Siemens regenerative gas-furnace, known as the "continuous melting tank furnace." Through the kindness of Messrs. Howson and Wilson, of Middlesbrough, the author is enabled to give a drawing of one these furnaces, showing all the latest improvements. It has been designed by Mr. P. E. Eloitt, late of Messrs. Chance Brothers, of Birmingham, the well-known glass-makers. It is arranged to work with gas made by a Wilson's

gas producer, and is considered to be a great improvement upon the furnace employed at the slag glass-works at Finedon.

The material is fused and amalgamated in a melting tank. The fluid metal, becoming fused, flows through a bridge, into a secondary chamber, called the gathering basin. The glass is withdrawn from this basin through a series of holes by the workmen, and fashioned into bottles, or other useful articles, in the usual way. By this arrangement, the work of charging and withdrawing the liquid glass is continuous, and proceeds uninterruptedly from Monday morning till Saturday night.

Messrs. Howson and Wilson assure the author that, with one of their gas producers, the consumption of coal per ton of slag glass should not exceed 10 to 12 cwts. With each charge of molten slag into the melting tank, alkalies and sand, and colouring or decolorising material, are added in proportion, depending on the quality and colour of, and the composition of, the glass required.

So far, the only slag operated upon is that produced from the Finedon furnaces in Northamptonshire, a very siliceous slag, the analysis of which is as follows:—

Silica				38·00
Alumina				14·87
Protoxide of iron				0·36
Protoxide of manganese				0·39
Lime				38·19
Magnesia				1·90
Titanic acid				1·00
Potash				1·58
Calcium..	1·55	as	Calcium	2·79
Sulphur..	1·24		Sulphide	
				99·03

To make bottle glass equal in quality and appearance to French champagne and claret glass, about 50 per cent. of slag may be used; for plate-glass, the same proportion, or rather less of slag; but, for glass for heavier articles, a much larger percentage can be adopted. Bottles made from slag glass are stronger than those manufactured in the ordinary way from the usual materials, and will stand from 320 to 350 lbs. per square inch, half bottles (pints) from 420 to 450 lbs. per square inch. Slag glass, owing to its toughness, is especially suitable for manufacturing into tiles, cisterns, plates, pipes, slates, &c., for which glass is not now employed. The chief points of merit claimed for the process are the utilisation of a waste product, the economising the heat of the molten slag, and converting it, with additional materials, into good glass, quicker, and at less cost, than by the processes generally employed.

The author has now revised the various processes where the slag is used in its crude cold state, or where the molten slag is either run into castings, or dealt with as in Mr. Brittain's process, and will now proceed to describe the inventions and manufactures with which his name is associated.

In 1871, the waste land for the deposit of the slag at the Tees Iron Works being filled up, and the works of the Tees Conservancy having temporarily been brought to a stand-still, it became of serious moment to know what was to be done with the slag.

The cost of cooling the slag, and putting it on board barges for taking it out and tipping it into the sea, was so heavy, that it was suggested that the slag should be prepared in such a form that it could be tipped into the barges, in the same way as coal is done upon the Tyne and other places. To meet these requirements, several schemes were proposed and tried; amongst the first (and only successful one) is the horizontal rotary slag-cooling table, designed and patented by the author, and which, with little alteration, continues to work up to the present time.

The machine upon which the slag falls revolves very slowly, and is about 16 feet in diameter. The top of this table is formed by a series of slabs; these receiving or cooling plates, or slabs, are about two feet in width, each forming a segment of the circle. These plates are kept cool by having a zig-zag wrought-iron pipe cast in them, through which water circulates, being fed from a centre globe; the water, after passing through two plates, flows into the basin under the table. These water plates are bolted down in such a way as to be able freely to expand and contract. The liquid slag, as it flows from the usual runner, spreads itself upon the moving table into a broad band of slag, varying in thickness from half an inch to three quarters, depending upon the quantity and fluidity of the slag. From the point where the table receives the molten slag, a distance is traversed of about 10 or 12 feet, to allow the slag to consolidate; after which, water from a jet is made to flow freely upon the surface of the hot slag until it reaches a set of scrapers, when, having become nearly cool, it is pushed off into iron wagons below.

When the slag reaches the scrapers, it has become somewhat brittle, and readily parts from the table, and slides off in large flat pieces. When perfectly cold, it is tipped from the wagons, and falls into small-sized pieces, samples of which are shown. This material was christened by Mr. Fowler, the Tees Commissioners' Engineer, "slag shingle," by which name it is now commonly known.

The produce of this machine has found such ready sale that it has been kept going almost constantly ever since it started, and about 200,000 tons have been sold, chiefly for making concrete. In place of paying 6d. per ton to get rid of it, it has realised about 1s. 3d. per ton.

The large concrete blocks, each weighing about 230 tons, constructed by Mr. Fowler, for dropping into the sea, to form the head of the Tees breakwater, are chiefly composed of this material, and several heavy foundations for engines, drainage work, building, &c., in the district, have been executed with it.

The next great step in advance, and which has laid the foundation for the several processes hereinafter mentioned, was the reduction of the molten slag, as it flows from the furnace, into a soft spongy kind of sand, by a machine known as Wood's slag-sand machine. In principle, it is the reverse of the slag-shingle machine, inasmuch as, instead of the wheel being horizontal, and the slag running upon a dry table, the slag flows into a wheel placed upon its edge, and falls into a bath of water, varying in depth from 18 to 24 inches. The wheel, or drum, is of wrought iron, and about 14 feet in

diameter. It is fixed and carried on curved arms. The arms are curved, to allow, in the first place, the slag runner, or spout, to enter the wheel; and, secondly, to make room for the sand-receiving spout on the opposite side at the top. The wheel makes about five revolutions per minute, and the water contained inside is partly carried up by the elevators, and in falling, causes a constant rush of water to the bottom. Perforated screens, or elevators, are arranged to screen the slag from the water, and lift it to the top of the machine, where it drops upon the sand-receiving spout, and thence slides in a constant stream into wooden wagons. The spout is also perforated, to allow any water which has been carried over with the sand to return again into the machine. The perforated buckets have another important function to perform, viz., that of agitating the water. The water, in rushing to the bottom, meeting these obstructions, rolls over in a violent manner, and into this agitated water the liquid slag flows just as it comes from the furnace. The united action of the agitated water and the formation of steam scatters, as it were, the molten slag in the water into the material called slag-sand, some of which is exhibited; as also a working model of the machine. The wear and tear of this machine is very light, there being no working parts coming in contact with the sand or the heat. The heat, being taken up by the water, is thrown off in the shape of steam, which comes away in large volumes. Grey slag takes up about 20 per cent. of its own weight in water. The total cost of this sand in railway trucks is about 6d. per ton. At the Tees Iron Works the author has three of these machines and two shingle machines generally at work.

On the Continent, a kind of slag sand has been made—prior to the adoption of the process just mentioned—by running the slag into tanks full of water, and elevating the sand by chain buckets into wagons; but the apparatus is very imperfect, and will only work slag made from forge iron, known as black slag.

The application of slag-sand, in so cheap a form, to the useful arts naturally followed the production, and, after numerous experiments, extending over many months, it was decided to establish separate works in close proximity to the furnaces, where, under the author's own directions, various processes could be developed; and, in 1876, the first manufactory of the kind was started. Although in Georgemarienhutte, in Hanover, under the direction of Herr Luurnan, a process of brickmaking was started a few months previously.

The remarkable setting properties of slag in a state of subdivision has attracted the attention of scientific men for many years, and many schemes for producing artificial stone, cement, &c., have been tried; but, in consequence chiefly of the cost of disintegration, no results were obtained with commercial success.

Mr. John Gjers, of Middlesbrough, about fifteen years since, produced a coarse kind of slag-sand, which, after grinding under edge-runners, was used extensively for some little time upon the pig beds; but it had to be abandoned, because it consolidated too much, causing violent explosions (technically termed "boils"), from the steam from the damp sand being unable to escape when the metal was run from the furnace in pigs.

Thus it will be observed that, up to the time when the Cleveland Slag Works was started, there was not a single instance of slag utilisation in this country—otherwise than for road-making, or for river work—commercially carried on. Before proceeding to describe the various manufactures produced at the Cleveland Slag Works, at Middlesbrough, it is necessary to draw your attention to the chemical nature of the material operated upon. The following analysis gives a good general idea of the chief slags produced in the United Kingdom.

	Cleveland.	Hematite Bessemer.	Dowlais.	Dudley.
Lime	32·68	50·55	30·47	35·68
Silica	36·50	30·50	43·07	38·76
Alumina	22·95	15·00	14·85	14·48
Protoxide of iron	0·06	0·45	2·53	1·18
Protoxide of manganese	0·32	0·10	1·37	0·23
Magnesia	5·83	2·00	5·87	6·84
Potash	0·59	0·40	1·84	1·11
Soda	0·37	0·20	..	..
Sulphur	1·73	1·50	0·89	0·98
Phosphoric acid				
	100·90	100·70	100·89	99·26
Less oxygen of the lime combined with sulphur	0·86	0·75	0·44	..
	100·04	99·95	100·45	..

A table of comparative analysis is given on the next page, for easy reference. It will be noticed that three most important component parts of these slags are silica, alumina, and lime, forming, as they do, about 90 per cent. of the whole. The two latter of these, however, chiefly exist as silicates; if, to these caustic lime be added, the silicates are acted upon. Water of combination, or crystallisation, is taken up; and, if the material be kept damp and exposed to the air, hardening or induration is carried on for months.

If caustic lime be added to slags poor in lime, so as to bring this element up to 55 or 60 per cent., it will be seen at once how closely it will resemble the analysis of Portland cement, the composition of which is as follows:—Lime, 60 per cent.; silica, 24 per cent.; alumina, 8 per cent.; oxide of iron, 4 per cent.

German Portland cement is sometimes made with as low as 55 per cent. of lime, whilst Roman cement has often only 50 per cent. of lime; but these will generally be found to contain oxides of iron in an increased proportion.

The remarkable hardening effect of oxides of iron in conjunction with lime, silica, and alumina, is well known, and is well exemplified in the Italian puzzolanas, where, in several of the best qualities, the lime is actually as low as eight per cent., whilst the oxides of iron run up to 12 or 15 per cent. The hardening effect of oxides of iron induced the author, prior to the development of the slag industries, to employ the dust from the ironstone clamps in place of sand, when making concrete for

	Slag.				Portland Cement.	Slag Concrete Bricks.	Slag Cement.	Gypsum.	Puzzalanas.
	Hematite Bessemer.	Cleveland.	Dowlais.	Dudley.					
Lime	50·55	32·68	30·47	35·68	60·88	29·90	22·90	32·32	8·00
Silica	30·50	36·50	43·07	38·76	23·16	25·15	21·60	0·35	..
Alumina	15·00	22·95	14·85	14·48	7·68	21·80	19·85	..	..
Protoxide of Iron	0·45	0·06	2·53	1·18	..	1·44	4·00	..	..
Protoxide of Manganese	0·10	0·31	1·37	0·23	..	0·26	0·21	..	..
Peroxide of Iron	..	..	..	..	3·00	1·66	8·80	..	12 to 15
Magnesia	2·00	5·83	5·87	6·84	1·01	5·10	4·36	..	..
Potash	0·40	0·59	1·84	1·11	0·72	0·53	0·50	..	..
Soda	0·20	0·37	..	..	0·31	0·36	0·32	..	..
Sulphur	1·50	1·73	0·89	0·98	0·05	1·00	1·19	..	..
Sulphuric Acid	..	..	..	..	2·60	1·25	1·54	46·18	..
Phosphoric Acid	..	..	..	..	0·08	0·01	0·02	..	..
Carbonic Acid	..	..	..	..	..	2·60	3·00	..	..
Water (of crystallisation)	..	..	..	..	0·77	9·50	12·00	21·00	..

heavy foundations; and the setting properties and strength of this combination have upon examination been fully confirmed. Again, having to erect a row of columns for a large roof upon the bed of an old ironstone clamp, the floor of which had been accumulating for several years, it was found to be so extremely hard, that the author simply levelled the bed down, and set the columns directly upon it. These, after many years, show not the slightest signs of settlement, although the ground underneath had been made up from ship's ballast.

It appears an absolute necessity for obtaining good results, that the ferruginous material should be calcined, or roasted, the effect of which is to drive off the carbonic acid and water; the re-absorption of the water, which unites in chemical combination with the material, afterwards assists in hardening.

These remarks would seem to be a digression from the question of slag utilisation, but, as will be seen hereinafter, they bear directly upon the manufactures carried on at the Cleveland Slag Works.

The most important production, and the one which consumes by far the greatest quantity of slag, are concrete-bricks, known in the market as slag-bricks. These bricks are made from the sand produced by the slag-sand machine before described. The sand is dropped from the railway wagons into hoppers, or depôts, at the works, from whence it is filled into large barrows, and is taken up a hoist to the top of the building, and tipped into a hopper, which supplies a measuring apparatus. Here it is mixed with a certain quantity of selenitic lime (General Scott's patent), with an addition of iron oxides; it then passes into the brick-press, hereinafter to be described. The bricks are taken off the presses by girls, placed upon spring-barrows carrying fifty bricks each, and removed to air-hardening sheds; here they remain a week or ten days, after which they are stacked in the air to further harden, and at the expiration of five or six weeks they are ready for the market. Specimens of these bricks are shown. We here have, then, the curious anomaly of bricks being made without burning, and of a wet season being favourable to the hardening process. The bricks thus produced are very tough; they do not split when a nail is driven into them, and are easily cut; they do not break in transit, and the frost has no effect upon them. According to a certificate received from Kirkaldy's testing works, some of these bricks, taken from stock three years old, carried a pressure of 21 tons before crushing, whilst, others only four months old, crushed with nine tons pressure, showing not only great toughness, but also that they greatly improve by age.

There are now two machines fully employed, making about 130,000 bricks weekly, consuming 250 tons of slag-sand and 30 tons of selenitic lime and oxides.

The preparation of this selenitic lime forms a necessary branch of the business. It is made in the following manner:—

80 per cent. of unslaked common lime.
10 per cent. of raw gypsum.
10 per cent. of iron oxides calcined.

These are all ground together, under edge runners, into a fine dry powder. The composition is then passed through a fine sieve, 24 meshes to the inch; it is then ready for the brick press. To each thousand of bricks, 6 cwt. of this lime is used; no water is added, sufficient being held in suspension in the slag-sand to thoroughly moisten the lime; in fact, it is no uncommon thing to find a stream of water flowing from the brick press which has been squeezed out of the sand.

The loss of bricks in manufacture is very small; in fact, after the bricks are once upon the barrows, the waste is not more than $1\frac{1}{2}$ per cent.

At the present rate of production, there is a consumption of slag for this one article alone of about 14,000 tons per annum.

The weight of these bricks is about 30 per cent. lighter than ordinary red ones—9 in. by $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in.—weighing only $2\frac{1}{4}$ tons per thousand.

Another interesting feature in connection with these bricks is the economy in manufacture, which—including all materials, labour, wear and tear of machinery, &c., superintendence, power,

and everything except interest on capital—does not exceed 10s. 6d. per thousand.

The following is an analysis of these bricks, made by Messrs. Patterson and Stead, and will be found worthy of notice, showing the hardening properties contained, the composition comparing favourably with the cements previously mentioned.

	Per cent.
Lime	29·90
Silica	25·15
Alumina	21·80
Protoxide of iron	1·44
Protoxide of manganese	0·26
Peroxide of iron	1·66
Magnesia	5·10
Potash	0·53
Soda	0·36
Sulphur	1·00
Sulphuric acid	1·25
Phosphoric acid	0·01
Carbonic acid	2·60
Total water	9·50
	100·56
Less oxygen of the lime combined with sulphur	0·50
	100·06

As before-mentioned, the lime used for making bricks is selenitised, the following being the analysis of the raw gypsum employed in the process.

	Per cent.	
Sulphuric acid	46·18	Sulphate of lime.
Lime	32·32	
Silica	0·35	
Water at 100 per cent.	Nil	
Ditto given off at red heat, being water of crystallisation	21·00	
	99·85	

The process of brick-making, as now carried on, is extremely simple, and, as already shown, inexpensive; but it was here that the greatest difficulties were met with.

There was no machinery to be purchased that could work the slag-sand into bricks, in the state in which it arrived from the blast furnaces. In the earlier attempts the sand had to be prepared in a fine state, the result being a superior class of bricks, but of a cost so great as to exclude them from the market. The author had, therefore, to design and construct brick presses and other machinery that could work the sand, as it came from the slag-sand machines, directly into bricks. The success of this machinery at once rescued the Cleveland Slag Company from an early collapse, but not before a large amount of money had been spent, and some two years wasted.

A description of this machinery is given further on; but, in designing the press, the following points had to be kept in view, viz.: unusual depth of brick moulds, as the sand (being spongy) is exceedingly compressible; great pressure, in order to consolidate the slag; as well as great care in mixing the lime in fixed proportions to the sand—too much lime tending to burst the bricks, whilst too little seriously affects the hardening.

The next product to be described is the manufacture of what is called slag-cement. The word cement has sometimes been objected to in connection with this material, because it is generally manufactured in a wet state, and must be used within a few hours of its being made. Upon this point the author expresses no opinion, simply mentioning the fact that, in point of strength, he finds little difference whether the materials are ground together in a dry or in a wet state. The cost of production, however, is, as nearly as possible, four to one in favour of the wet state. It is made by grinding under edge runners, for about one hour (the finer the better), 70 per cent. of slag-sand, 15 per cent. of common lime, and 15 per cent. of iron oxides, calcined iron stone, or spent pyrites.

The following is an analysis of this cement, lately made by Messrs. Patterson and Stead:—

	Per cent.
Lime	22·90
Silica	21·61
Alumina	19·85
Protoxide of iron	4·00
Protoxide of magnesia	0·21
Peroxide of iron	8·80
Magnesia	4·36
Potash	0·50
Soda	0·32
Sulphur	1·19
Sulphuric acid	1·54
Phosphoric acid	0·02
Carbonic acid	3·00
Total water	12·00
	100·29
Less oxygen of the lime combined with sulphur	0·59
	99·70

Upon comparing this analysis with that of Portland cement, and the puzzolanas already given, it will be seen that the various hardening ingredients exists in all.

The large quantity of water held in suspension in the slag-sand, is quite sufficient to make the mass in the mill into a semi-fluid state, but this water is mostly taken up in setting, as water of crystallisation. It is, therefore, necessary that the cement should be used before setting takes place. This cement is usually employed for making concrete, by mixing one part of the cement to five parts of slag-shingle. The shingle is made by the slag-shingle machine before described.

The shingle, before being used, is well wetted; and when the concrete is put into place, it is beaten lightly down in a soft state, until the water and cement begins to rise on the top; two days afterwards it has become sufficiently set to allow of the building boards being taken down, and at the end of a week it will be fairly hard, and will go on hardening for months. It is perfectly hydraulic, and will harden under water. It will be seen by this, that it requires longer time to set than Portland cement, and is perhaps not quite so hard; but there is a remarkable toughness, which has surprised all those who have used it, and this toughness makes it valuable for heavy machinery foundations, &c.; and, when made in proximity to the furnaces, the cost of the cement will not exceed 6s. per ton, whilst concrete made of this cement and slag-shingle will cost only 5s. 6d. per cubic yard.

These prices are absolute figures of cost, that of the concrete being arrived at after having executed many hundreds of cubic yards, both upon the Tees Iron Works, at the new railway station at Middlesbrough, and elsewhere. The Slag Works-buildings, the walls of which are between 70 and 80 feet high, are built entirely with it, the basement walls being 2½ feet thick.

Whilst the underground walls of the Slag Works were being executed, they were twice immersed, through exceedingly high tides, with the result that this part of the building is the hardest of all; and to give an idea of the strength, the author may mention that it was necessary, about eighteen months ago, to cut two openings at different points through the basement walls, 3½ feet wide and 6 feet high. This employed two good workmen, with steel bars and sledge hammers, at least four days for each doorway.

The author knows of no material at a similar cost which can compete with it, and he is satisfied that it has only to be widely known to be more extensively used. Personally, where time can be given, he employs nothing else for all heavy foundations for rolling machinery, for which purposes, as a conglomerate or monolithic mass, it is peculiarly adapted. Slags from the furnaces making Bessemer iron are better adapted to this cement even than those from the Cleveland ores.

Mention has been made of the necessity of keeping the products from slag-sand in a damp state for a length of time after manufacture, in order to give them time to harden, or, in other words, to allow the material to absorb or take up as much water as will chemically combine with the lime, silica, and alumina; but whether this water becomes water of crystallisation, or water of hydration, or a combination of both, is not at all certain. The author is, however, strongly impressed with the idea that water in a fixed state, more particularly in a compound state, plays by far a more important part in the setting of cements than is generally supposed; that the presence of water in a chemically combined state forms as much a constituent part of cement as does the lime, silica, and alumina, seems certain from the results of the analysis shown further on. For instance, if Portland cement be heated to a red heat, so as to evaporate the fixed water, the cement loses at once its strength, and becomes rotten. Again, with gypsum, where the water of crystallisation amounts to more than one-fifth of its bulk; if this is driven off at a red heat, we have little better than a powder left. And it seems clear that the quicker this crystalisation takes place, the quicker is the setting; and, on the contrary, as in the slag cements and the brick, the slower the water is in becoming fixed, the slower is the hardening, thus showing the necessity of keeping them damp during the process.

At the author's request, Messrs. Patterson and Stead have made many analyses, with the object of testing this point. Samples of Portland and Roman cements were mixed with water in the usual way, some specimens being supplied by the cement manufacturers themselves, as test pieces from their works, and had consequently been under water for various periods. These were all reduced to powder, and carefully dried by keeping them for several hours at a temperature of 212° Fahr., so as to evaporate every particle of free mechanically mixed water. A very careful determination of the chemically combined water was then made, with the following interesting results:—

Combined Water.

Four days in water.		Six days in water.	
Portland.	Roman.	Portland.	Roman.
5·75%	5·25%	6·8%	6·78%

Seven days in water.

Portland.	Slag cement.	Slag brick.
7·75%	10·50%	5·70%

From this it seems certain that the hardening follows closely in proportion the quantity of water which becomes chemically combined, and that the slag cement undergoes a similar change to that which takes place in Portland or Roman cements. That other chemical changes take place there seems also to be no doubt, but what these changes are, the author leaves to wiser heads than his own; he only wishes to show that with Portland, or Roman, or slag-cement—time being left out of the question—the same chemical changes do take place.

Mortar for building purposes is also another material supplied at the Cleveland Slag Works. It is simply made by grinding the slag sand with about six per cent. of slaked lime in an ordinary mortar mill, and (if ground fine) makes a far better mortar than is generally employed by builders. Two years ago there was a very large demand for this material in Middlesbrough, but the building trade has so completely come to a stand-still, that at the present time not much is being used. There is only one objection made to it, viz., that it sets too quickly. Mortar supplied on the Saturday, left unused, would be worthless on the Monday. As with the other slag products, its remarkable strength and cheapness combined makes it much liked by those who, in close proximity to the works, can obtain it freshly made.

One other manufacture from slag is carried on at the Cleveland Slag Works, which, although it does not consume much, is still of interest, viz., artificial stone. It is moulded into chimney-pieces, window-heads and sills, balustrading, wall coping, and other ornamental work for builders, as well as for paving for footpaths, stables, &c. The stone is composed of two and a-half parts of finely pulverised slag, and two and a-half parts of ground fire-brick, to one part of Portland cement; the mixture is run into moulds, and sets quickly, the articles being ready for the market in five or six days.

In a works where so many special manufactures have been developed, the arrangement of the building—the design, position, and working of the machinery at present used—must necessarily have been arrived at only by hard-earned experience; and the author has thought that this paper would be incomplete without a description of the factory at Middlesbrough, with such further modification as an experience of five years' working has suggested.

The building is constructed of slag-cement concrete throughout; the main building has four floors, the size of which are 46 feet by 33 feet, whilst the slag-sand stores, gantry, engine house,

lime house, &c., occupies 97 feet by 47 feet. The slag-sand is brought from the blast furnaces in large wooden railway trucks, holding between seven and eight tons each, and is run up an incline by the locomotive into a gantry. The bottom doors of the trucks are opened, and the slag-sand is dropped or emptied into hoppers below. These hoppers are capable of holding about 600 tons of slag-sand, or storage enough for one week for three machines, and should be kept constantly filled. From these hoppers it is drawn into large wheel-barrows, and is taken up by a double-acting hoist to the top of the building.

This hoist is driven from the main shafting in the mill, and is worked by two belts, one crossed, the other open, for the purpose of reversing the cages. The cages can be made to stop themselves at any floor, and have a self-acting brake to prevent any movement of the cages after the straps are thrown off, the action being most simple and effectual.

The sand-barrows are taken from the hoist at the top of the building, through a passage, and tipped into the hopper, which supplies the brick presses. Selenitic lime is fed into a small hopper, by hand, from a chamber or floor above. At the bottom of these sand and lime hoppers are the measuring apparatus, which accurately measure both the lime and the sand in the exact proportions necessary. From the measuring drums, the material falls upon sifting and mixing apparatus, from which it falls through the floor into the brick press. This press has been designed especially for the purpose, and has many new points. It is of immense strength. The pressure is obtained by two cast-steel cams, which are fixed upon a forged steel shaft $7\frac{1}{4}$ inches in diameter; this shaft, resting on bearings between two strong frames, is put in motion by very powerful double-geared spur wheels, the first motion shaft having a heavy fly-wheel upon it to steady and equalise the pull upon the strap. The pressure cams act against rollers fixed upon two steel cylinders, or rams. These rams transmit the pressure to the moulds under the table. The table is circular, and contains six pairs of moulds, so that four bricks are pressed at one time, the table remaining stationary during the operation. At the same time the bricks are being pressed, two other pairs of moulds are being filled up with material, whilst the other two pairs are delivering up the four bricks already pressed at the previous revolution of the cam shaft. The bricks are pushed out of the mould by smaller pistons, which are acted upon by separate cams. The moulds are lined with changeable steel plates three-sixteenths of an inch thick, and the sand and lime is fed into two pug-mills. These pug-mills are fitted with six knives each, so as the more thoroughly to mix and chop the spongy slag with the lime. The table is shifted round by a kind of ratchet motion. Immediately above the pressure-cylinders are two pressure-stops, which are held down by the heavy-weighted levers. These levers therefore, receive the whole pressure put upon the bricks; and, in case there should be too much sand getting into the moulds, they simply lift up and relieve the strain. The weights can be weighted at option, and thus form an exact gauge of the pressure upon the bricks. The moulds are generally filled so as just to lift the levers in ordinary work. The filling is easily regulated by the set of the knives on the pug shafts, which press the material into the mould and one side of the pug-mill cylinder is made to open so that the knives are accessible at any moment.

The pug-mills are filled by means of measuring and mixing apparatus placed on the floor immediately above the brick press. The mixing and measuring apparatus is very simple and efficient, and works without trouble. The slag-sand is tipped into a hopper by large barrows, which are lifted up by a hoist. At the bottom of this hopper there is a revolving cylinder, with ribs cast upon it, which, revolving under the hopper, carries a certain thickness of sand, the thickness having been previously regulated to the requirements of the press. The slag then falls upon a sieve, which separates any large pieces of slag in a solid state, and at the same time allows the falling sand through the sieve to fall like a shower. The lime is fed into a separate hopper, and is regulated by a feed-roller of smaller size. The lime then passes down a shoot, which forms part of the slag-sand sieve, where it meets the shower of sand—falling together with it—thus getting thoroughly mixed. On the right-hand side of the slag gantry and hoppers is the mill for preparing the selenitic lime. The lime, after being ground under edge runners, is passed through a sifting apparatus, the wire of which has 24 meshes to the inch; it then falls into a hopper, is taken by barrows through a passage to the hoist, and lifted to the lime chamber, before mentioned. In a line with this mill, and parallel with the slag gantry, are the stores for the lime, gypsum, and iron oxides, whilst behind the lime-house are the engine and boiler.

The hardening sheds are three in number, and should be each about 100 feet to 40 feet. The floor must be perfectly smooth and level—this being an important point—as an uneven floor spoils the bricks. The sheds should have plenty of ventilation, and require to be cool in summer. Great care is necessary in stacking these bricks, as they come off the barrows. They are placed on edge quite close together, and stacked six in height, and when once here in position, there is little or no loss afterwards.

A material containing so much lime, silica, alumina, sulphur, and magnesia, in a condition like the white soft slag sand, suggested its application as a fertiliser for some kinds of land. Three years ago, through the kindness of Earl Cathcart, it was brought before the Royal Agricultural society, and Dr. Voelcker reported "that the result of his examination shows that it may be usefully employed upon moorland and peaty soils as a cheap and effective substitute for lime."

Since this report was made, many hundreds of tons have been sold for this purpose, and although there was only 32 per cent. of lime in the slag supplied, the results have been very satisfactory, particularly on land growing potatoes. Had it been Bessemer slag, containing from 40 to 50 per cent. of lime, there cannot be a doubt but that the results would have been still more satisfactory, and the author feels sure that it must, in some localities, find a large outlet for this purpose.

Mr. Frederick Ransome, M.Inst.C.E., the well-known inventor of the artificial, siliceous stone, has recently taken out a patent for mixing the slag-sand in its wet state with chalk, and then burning the whole together in a cement kiln into clinker, after which he grinds it down in the same way as Portland cement. The results given are most remarkable, exceeding Portland cement in strength by nearly 30 per cent. The experiments are of so recent date, that the author has considered it better not to give any further statistics.

A sort of concrete brick has, during the last few years, been made at the Moss Bay Iron Company, Limited, Workington, from hematite Bessemer slag, under the direction of Messrs. Kirk Brothers, Mr. Henry Hobson being the then manager, and, I believe, the originator of the process. These bricks have been made by a process differing entirely from the system adopted by the author at Middlesbrough, and already fully described. The slag employed at Moss Bay is pulverised from the cold solid slag, under massive edge runners, which crush the material into fine dusty shingle, it is then lifted by elevators into French burr stones, and ground down as fine as sand. From the stones, it passes through a worm conveyor to a brick press, during which, about 25 per cent. of common river sand is added, with sufficient water to thoroughly damp it, without any addition of lime, again showing, in a remarkable degree, the extraordinary setting nature of the slag, after the chemical combination with the water and exposure to the air has taken place. These bricks are taken from the press, and placed under cover for a few days, when they are put out in the open air to harden. The bricks are of excellent shape, grey colour, and become exceedingly hard, as will be seen from the specimens exhibited. Large quantities of these bricks have been employed in building the Moss Bay Steel Works, and appear to be standing remarkably well. The cost, however, is very heavy, owing to the difficulty of preparing the slag, and the wear and tear of the machinery; the excessive weight also precluding the sale at any great distance from the works.

The large amount of lime, combined with the silica and alumina in the Bessemer slag, as seen in the analysis already given, quite accounts for the setting properties. With the exception of the bricks used upon the works, the author believes that there has not been any large quantity made, and the machinery has now been standing many months. The process is, however, again another proof, in a very interesting way, of the peculiarities of the material. The bricks continue to harden for years, and appear to arrive at a kind of crystalline fracture, which damp greatly accelerates. There is no doubt whatever that if this slag were treated by the process adopted by the author, that bricks, in every way superior to the ones just described, and, from the nature of the slag, superior, even as a building brick, to those produced at Middlesbrough.

There remains, now, only one more application of blast furnace slag for the author to trouble you with. It is the manufacture of slag wool, or silicate cotton, so-called from its resemblance to cotton-wool. The first attempt at this manufacture was in 1840, by Mr. Edward Parry, in Wales, and a large quantity was made, but no effort appears to have been made to confine the wool after production, consequently it floated about the works with the slightest breeze, and became so injurious to the men that the process had to be abandoned.

About four years ago, Herr Krupp, of Essen, and a little later, Herr Lurman, of Georgmarienhutte, in Hanover, both supplied a great deal to the market, but the precise methods of manufacture has never transpired, having been kept a secret at the works; and until two years ago, it had never been successfully made in this country.

As carried out by the author at the Tees Iron Works, the process is exceedingly simple; a jet of steam is made to strike upon the stream of molten slag, as it flows from the usual spout into the slag waggons, or bogies. The steam scatters the slag into shot. As each shot leaves the molten stream, it draws out a fine thread, just in the same way as when you touch treacle lightly with the finger; if you lift it up you will see a fine thread attached. The consistency of molten slag is not unlike treacle; each shot makes a fine thread which, losing its heat, becomes set like glass. The shot being heavy, drops to the ground, but the thread is sucked into a large tube by an induced current of air, caused by the steam jets, and the wool is discharged into a large chamber. The finer qualities float about and settle near the outside, whilst the heavier or larger fibres lie chiefly in the centre of the chamber. After each blowing, the chamber presents a most remarkable and curious, as well as a beautiful appearance.

The wool, as will be seen by the specimens shown, is of snow-white colour, and attaches itself to the sides and roof, or to anything which it can touch, in the same manner as a light fall of snow does in calm weather upon every tiny twig of a leafless tree. The wool is taken up daily with forks, and put into bags for sending away. It is principally used for covering boilers or steam-pipes, for which purpose it is peculiarly adapted, as being a splendid non-conductor of heat, and incombustible. About four tons of this wool is produced per week, and, as only one quarter of a cwt. is made from each ton of molten slag operated upon, you will see that the process is not a very rapid one.

In conclusion, the author hopes that the progress which has been made during the last few years towards the utilisation of this hitherto neglected material may induce others to assist in converting it still further into what is useful to man, and in place of being an incumbrance and a nuisance, continually encroaching upon valuable land, it will more and more assume a condition of value.

DISCUSSION.

The Chairman said all must agree that they had just heard a most interesting and able paper, on a subject of great moment to the industry of the country. The whole question of the utilisation of waste products, was one in which the nation at large was deeply interested, and it was illustrated in this paper in a most remarkable manner. Only a few years ago, no one knew what to do with this waste product, which was actually thrown into the sea at great expense, in order to get rid of it. It had also accumulated to an enormous extent, so that it made quite mountains in the

iron districts; but it now turned out to be suitable for some of the most useful manufactures.

Mr. Reid said he had made some experiments on the application of slag to the manufacture of Portland cement, and could not say that he got very satisfactory results, but that was before Mr. Wood's granulated slag was to be had. He found the greatest difficulty with the sulphur. He got in his slag about $1\frac{3}{4}$ per cent. of sulphide of calcium, which would amount to about 2·84 per cent. of sulphide of lime in the cement when finished, an amount which made the cement very unreliable. He found also that, in working up the slag with the lime, it was very difficult to incorporate the two thoroughly; but it was very possible that this granulated slag of Mr. Wood's, which was very finely divided, might be more easily mixed with lime. The amount of sulphur usually contained in Portland cement had not been given, but according to a paper read on the preceding day by Mr. Grant, it was nearly 2 per cent. If you were to make cement from slag already containing 12 per cent. of sulphur, you would get 4 per cent. of sulphate of lime in it, which would render it unreliable. He mentioned these points, because he had spent a good deal of time and money over this question, in order that others might know the difficulties likely to arise. This process was patented by Mr. Bodmer in 1866, so that he did not think anyone need be afraid now of making Portland cement from slag. The specification stated that the invention consisted in the manufacture of a cement by mixing together slag cinder or scoria, whether natural, or artificially produced from furnaces, with a certain proportion of lime or calcareous matter, and with or without alumina. Again, in 1872, Mr. Eagleston read a paper on the utilisation of slag at the American Institute of Mining Engineers, and referred in that paper to blast furnace slags being used for various things, and amongst others for the manufacture of cements. He also said that the possibility of having them in the form of granulated slag, reduced the price of the pulverised material to a price so small that, in certain parts of Germany, an artificial cement, equal in every respect to the best Portland, was manufactured at a price so low as to realise a large profit. It was evident, therefore, that other people had had this before them for some time. With regard to the absorption of water by Portland cement and hydraulic limes, Mr. Wood said very correctly that that was, to some extent, a measure of the efficiency of these cements. The Austrian Association of Engineers had quite recently passed some rules for the testing of cement, in which it was recommended that the weight of the sample tested should be taken from day to day, so that in addition to the strength, the absorption of water should be registered.

Mr. Ransome said he had been very much interested by the able manner in which Mr. Wood had dealt with the subject. With reference to the particular part of the paper with which his name had been coupled, he did not desire at the present moment to say more than that the results stated by Mr. Wood had been thoroughly borne out. To go further into detail would be neither desirable at the present moment, nor consistent with the interests of other parties who were engaged in similar investigations, and he must, therefore, leave that to a future opportunity.

Mr. Redman remarked that one very important application of this material was that made by his friend, Mr. Fowler, at the Tees Breakwater. It so happened that along the north-eastern coast there was a great want of protection for shipping, as had been acknowledged for many years. Along the south-eastern coast there were some fine natural harbours, separated from each other by no very great distance. From the estuary of the Thames to Yarmouth roads was about 50 miles, from thence to the Wash estuary was another 50 miles, and from thence to the Humber was another reach of 50 miles, with an admirable natural harbour. But north of the Humber, along the whole coast of Yorkshire, Durham, and Northumberland, and even up to the Firth of Forth, there was a great want of protection to shipping, the result of which might be seen by a glance at the annual wreck-chart. Filey Bay, Flamborough Head, and Bridlington, had been proposed as sites for a harbour of refuge for years past, but their contiguity to a natural harbour had held the project in abeyance. Again, the increase in the amount of our commerce was also very remarkable. He might state broadly, that the aggregate foreign tonnage of the ports of London and Liverpool, being one-half of the whole of the kingdom, had trebled in the last 25 years, and the size of vessels had increased almost *pari passu*. This arose from the fact of the more general introduction of steamers, which had rendered passages shorter; and there was now a smaller number of vessels engaged in carrying larger tonnages, rendering it necessary not only to afford greater facilities for merchandise in docks, but also deeper approaches to the harbours. At Sunderland, Whitby, and other ports on the eastern coast, the authorities were alive to the necessity of giving greater accommodation to shipping; and, undoubtedly, these very interesting experiments, which had been going on now for a number of years by Mr. Fowler, at the estuary of the Tees, showed, that near at hand to the source of supply there was an admirable field for the use of this material. At Chatham, large concrete wharves had been in course of progress for some years, the face of which was vitrified by the use of slag concrete, put in behind boards by the convicts. This was found to form a most admirable surface to the wharves. He thought the paper most worthy the consideration of the Society.

The Chairman then proposed a vote of thanks to Mr. Wood for his instructive paper. He hoped that it would be widely read, and that the country would benefit by the results.

MISCELLANEOUS.

SCHOOLS OF COOKERY.

The following review of the circulars of information relating to the training schools of cookery, published by the Bureau of Education, Washington, was printed in the *Times* for April 16th. It shows what great results have followed from the founding of the National Training School for Cookery, established under the Commissioners for the Exhibition of 1851 at the International Exhibition of 1874:—

"Practical instruction in cookery, advocated by eminent educationalists, is gradually taking its position in the courses of instruction pursued at elementary schools. When the Committee of Council on Education was called into being in 1840, instruction in household economy was to be given in these schools. But this idea was not effectively carried out, and the present movement for establishing classes for practical cookery is of modern growth, owing its origin chiefly to the National Training School for Cookery. The lectures on food and its various technical arts which were de-

livered at the International Exhibition of 1874 led to the establishment of that institution. In the following year, the national importance of a knowledge of the properties and uses of food was marked by the Government offering to elementary schools a grant of 4s. per scholar who passed an examination in domestic economy, and this term included food and cookery. Edinburgh, Liverpool, Leeds, Manchester, Birmingham, Sheffield, and other large towns soon took part in the general movement, and the London and other School Boards have now formed centres for giving practical instruction in cookery. During the year 1877-78, grants under the Education Code were made to nearly 200 departments of elementary schools. This number will, no doubt, be increased as the payments upon results, which are made under the rules of the Education Code, are so directed as to give more immediate stimulus to instruction in cookery. The grant of 4s. per scholar for domestic economy is now split into two 2s. grants on account of cookery and food. Teachers of practical cookery are, however, much wanted, as the training colleges have not availed themselves of the privilege afforded them by the Education Department, which agreed to share the expenses of training a certain number of students from the colleges at the National Training School for Cookery.

"Recent reports of her Majesty's inspectors of schools, dwell upon the importance of practical instruction in cookery: 'the excessive waste in the labourer's kitchen is surely a crying evil enough to arouse the sympathy and interference of the Education Department, as well as of voluntary and charitable agencies.' In spite of what has been, and is being done, much remains to be done in this country to promote material prosperity by means of the proper uses of food.

"Beyond the limits of the United Kingdom the influence of the National Training School for Cookery is being extended. Colonies like Australia, Canada, Ceylon, and New Zealand are beginning to establish schools of cookery. We have now before us a report issued from the National Bureau of Education at Washington upon training schools of cookery in the United States of America. A lady, Mrs. S. A. Martha Canfield, is officially charged with the care of subjects of domestic education in that office. It appears that 'letters are received from persons who are devoted to the promotion of the welfare of mankind, and who have become alarmed as they have observed more closely the extent and serious character of the evils caused by bad cookery. This feeling has been emphasised by the distress which was caused by the late depression in business; and they desire more information of what has been accomplished by instruction in this subject, especially in Europe, which this office has peculiar facilities for obtaining.'

"A long account accordingly is given of the National Training School for Cookery at South Kensington, of the English Northern Union of Schools for Cookery, and of the Edinburgh and Liverpool Training Schools for Cookery. Little is said regarding instruction on the Continent beyond a passing remark upon the culinary thriftiness of the French as compared with other nations.

"In several of the larger cities of the United States cookery clubs exist, the lady members of which are generally proficient in cooking. The New York Cooking School, under the direction of Miss Juliet Corson, is widely known as the foremost of similar schools in America. It commenced work in 1874. Lectures were given on analysis of articles of food and the effect they would have on the system after they were eaten. Directions were then given as to choosing and buying such articles. In the kitchen the class of pupils watched the operations as performed by Miss Corson and her assistants. Two years subsequently practice classes for a limited number of pupils were instituted; and in 1877 a plain cook's class for practice was opened under a Board of lady managers. In 1878, Miss Corson commenced organizing local classes for teaching the working people; and she delivered lectures illustrated by demonstrations at various institutions like mission schools, orphan homes, and such like. In the demonstrations she had the assistance of girls from the training school.

"Besides compiling handbooks on domestic economy and cookery, Miss Corson has framed a considerable scheme, which, if adopted, will lead to the establishment of schools for training children of the working classes, schools for the instruction of plain cooks, schools for high-class cookery, and normal schools of cookery, where ladies can be taught the theory and practice of domestic economy.

"Following the example of New York, Boston has, with the assistance of Miss Maria Parloa, established a school of cookery. This lady has also helped in promoting similar work at Portsmouth, New Hampshire, at New London, Connecticut, and at Auburndale, Massachusetts. Montreal has its cooking school. The Industrial University has founded a school of domestic science, which aims at preparing young women for the housekeeper's duties. The degree of Bachelor of Science is conferred upon scholars in this school, who successfully pass a series of examinations in the subjects comprised under the title of domestic science. At Memphis, lectures on domestic economy are given in the Le Moyne Normal Institute, but as yet an experimental kitchen has not been provided to meet a want which is much felt. The Kansas State Agricultural College, Manhattan, acknowledges the importance of instruction in domestic economy and hygiene. A 'kitchen laboratory' has been here completely furnished, and affords 'every facility for drill in the art of cookery.' Domestic economy is fully taught at the Iowa Agricultural College, where the students have the use of both a kitchen and laundry The Raleigh Cooking School is modelled after the pattern of the South Kensington and New York schools. At Washington, Miss Corson headed the movement, which appears to have received influential support, and which is leading to the establishment of a school of cookery. Activity has been displayed in favour of spreading means of giving practical instruction in cookery in other districts. The success which has attended the efforts hitherto made is in the main to be traced to the energy with which Miss Corson has prosecuted her labours.

"In this country, as in America, all kinds of difficulties, pecuniary and otherwise, beset the carrying out of a system of practice classes. To fit up kitchens, to supply utensils, and deal economically with materials, tax the powers of school managers, whose principal ideas of educational plant or *matériel* have been confined to books, slates, pencils, paper, and pens. They require advice and assistance in such mattters at least, and it is in the power of the different educational organisations, whether of the State or of voluntary enterprise, to come to their aid. Cookery, an art of primary importance in advancing the domestic welfare of all classes of people, seems to deserve the attention especially of the various authorities who are at work to promote what is termed technical education."

On the same day, a leading article appeared in the same paper, from which the following is an abstract:—

"But none are more interested in good cookery than the poor. For their own needs they have to make the most of the least, the best of the worst, and everything with the fewest and humblest appliances, with no time to spare. The mother of the family has to clean and dress her children, and get them off to school before she can do anything towards the dinner. In the evening there arises again a severer conflict between her maternal and her conjugal duties. The upshot of all is that the most conspicuous feature in the poor man's meal is its ready-madeness; that is, the very little aid received

from art by nature. Boiled vegetables, dumpling, soaked bread, tea-kettle broth—that is, hot water with butter, or some equivalent, floating upon it—and a bit of boiled bacon, are the utmost meal provided for the poor man returning home cold, exhausted, and often wet through, at the end of a long day's work. The resources of the labourer's garden are few, and soon exhausted; and as for the herbs which Frenchwomen cull from the field and the roadside for the salad or the pot, the Englishwoman could not afford time for the search, even if her husband cared for a salad. But although the question seems thus reduced to a necessity admitting of small choice, it must not be forgotten that the English labourer's diet has changed much within memory, in some respects for the better, in others for the worse. He will have only the finest wheaten bread, to the exclusion of some important constituents in the grain; he knows nothing of barley bread, of rye bread, or any combination, or of oatmeal cake or porridge, while his vegetables have been reduced year by year down to the monotonous and unreliable potato. The general effect on the health and strength of the poor is a question. On the one hand, the children of the poor, always out of doors except when at school, and dining on hard dumplings or simple lumps of bread, are often healthier and stronger, and even more happy, than the more favoured child whom parents, nurses, and cooks are tempting with new delicacies, and doctors are waiting to rescue from outward infection or inward disagreement. On the other hand, it is a very common remark that the rising generation is a stunted one in comparison with the past. But it is not only for themselves that the poor have to learn cookery. They have to cook for their betters. At the age of fourteen the village girl, and often the artisan's child also, has 'to go out to live.' Her first essay is generally as a maid of all work, when she has to do all the cookery required for some very economical household. At any age after that she may be called on to assist in the kitchens of the rich, and, unless the class of cooks is recruited from the ranks of common industry better than it has been lately, the rich will find themselves one day reduced to the painful necessity of cooking their own dinners, for the cry still increasing is that there is no cooks, and none can say where they are to come from. The school itself is largely answerable for the deficiency. Before the rigid and now universal enforcement of school attendance, the children saw a good deal of cookery, which, poor as it was, yet gave them some taste and an inkling of knowledge. They now see nothing, and they do nothing but read, write, sum, sew, or knit. Already physiologists are detecting in them the ill results of acquiring knowledge without the proper alternation of practical employment, and while we are casting about for some new remedy for a new complaint, we seem to have forgotten that we have withdrawn the poor children from their old healthy and instructive share in household duties. As the school has done some of the mischief, it is bound to do its part in mending matters. On the other side of the Atlantic, as will be seen by a paper in another column, some zealous ladies are doing their best to organise lectures, schools of cookery, and kitchens for demonstration. Our own department began with confessing the want, and has proceeded so much further as to offer head money for the children that pass in cookery or domestic economy, and to provide also the opportunities for a course of instruction to the pupils in the training colleges. Yet it is evident there the matter stops. Nothing serious is done. Other subjects are allowed to press their superior claims to notice, and at this moment we are even nearer than ever to the often foretold consummation when, with the best gifts of nature and the highest agricultural skill—indeed, with the best flesh, fish, and fowl in the world, we shall not be able to turn them to account because we have none to cook them."

BOILER EXPLOSIONS.

A report, containing particulars of visits of inspection and a record of boiler explosions from the 1st of January to the 23rd of April inclusive, was presented at the last meeting of the Manchester Steam Users' Association, by Mr. Lavington E. Fletcher, Chief Engineer, of which the following is a short abstract:—

From the 1st of January to the 23rd of April inclusive, 2,129 visits of inspection were made, and 3,830 boilers examined; 2,619 externally, 19 internally, 19 in the flues, and 1,173 entirely, while in addition 20 boilers were tested by hydraulic pressure. Three of these hydraulic tests were applied to boilers that had been already in use, to ascertain their fitness for the pressures proposed to be carried, while in the other 17 cases the boilers were new ones, and were tested, not only by hydraulic pressure, but also specially examined, both as regards their construction and complement of fittings, before leaving the maker's yard. During the above period the following defects have been met with:—Furnaces out of shape, 19; fractures, 49, 1 dangerous; blistered plates, 21; internal corrosion, 56; external ditto, 85, 1 dangerous; internal grooving, 66; external ditto, 2; blow-out apparatus out of order, 5; safety valves ditto, 8, 2 dangerous; pressure gauges ditto, 111; boilers without pressure gauges, 3; without blow-out apparatus, 5; without feed-back pressure valves, 16; cases of over pressure, 1; cases of deficiency of water, 1. Total defects, 448, 4 dangerous.

The present year has opened badly, as regards the number of persons killed, and though the loss of life in 1879 was less than the average of the last 15 years, the present year threatens to make up for it. Already eight steam-boiler explosions have occurred, killing 33 persons and injuring 32 others; while in addition, by the bursting of a tar boiler, 11 persons were killed and 6 injured, making a total of 44 persons killed and 38 injured from the 1st of January to the 23rd of April.

By one explosion that occurred at an ironworks at Glasgow, as many as 25 persons were killed and 23 others injured at one sweep. An inspector was sent to the scene of the catastrophe, to make an investigation according to the association's custom, and was furnished with an official introduction to the owners of the works, requesting permission to make an examination. There are no coroner's inquests held in Scotland, but such inquiries are conducted by the Procurator-Fiscal, and a further letter of introduction was therefore furnished to the Procurator. The association's inspector, however, was refused permission to examine the boiler both by the owner and by the Procurator-Fiscal, and had to return to Manchester without any information.

The action of the Procurator-Fiscal, with regard to boiler explosions, does not seem to be altogether accepted even in Scotland, and, on Monday, March 8th, 1880, Mr. Anderson, M.P. for Glasgow, asked the Home Secretary in the House of Commons "whether, seeing there were no coroner's inquiries in Scotland, he would arrange to have an efficient inquiry into the causes of the disastrous boiler explosion which had taken place in Glasgow." To this Mr. Cross replied "that such official inquiries had not been the practice in England, but seeing that in Scotland there were no coroner's inquests, he would place himself in communication with his learned friend, the Lord Advocate, on the subject."

The course that the association recommends (of instituting an investigation by an open court, very similar to the investigations now instituted in the event of a railway catastrophe, under the regulation of Railways Act of 1871, or in the event of a boiler explosion on board ship, under the Merchant Shipping Act of 1854) would meet this difficulty, and an illustration is afforded by the investigation now being conducted into the Tay-bridge disaster.

Two of the explosions that occurred this year show

how necessary more stringent investigations than those made by the coroner have become. In the case of one that occurred at Ormskirk, killing three men and injuring three others, from the wasting away of the plates at the bottom of the boiler till they were as thin as a sheet of paper, the jury returned a verdict of "Accidental death;" but while they expressed their regret that the boiler had not been periodically tested by experienced engineers, they added, in reply to the coroner, that they did not "impute blame to the owners in any respect." Competent inspection, however, would have prevented the explosion, and the owners neglected this simple precaution, which cost the three men their lives. In another case a boiler burst at Cork, and the jury, at the recommendation of the Coroner, returned a verdict to the effect that "the explosion was caused by the accumulated pressure of steam, in consequence of an inoperative safety-valve, acting on a bad plate, and that there was no negligence on the part of any person." Safety valves, however, are not inoperative without someone being negligent. It is the duty of those in charge to see that the valves are free. The verdict by a coroner's jury is so constantly one of "Accidental death," even though the boiler is worn out and unfit for use, that the coroner's court becomes to the reckless boiler owner very much what the debtor's sanctuary in the old days was to the spendthrift.

In the case of an explosion that occurred at sea, off the coast of Spain, on board a vessel plying from Bilbao to Newport, no coroner's inquest was held, but a court of investigation was instituted at Newport, under the Merchant Shipping Act of 1854. This Court made a searching inquiry into the cause of the explosion and the loss of life "resulting therefrom," and condemned the owners in "the sum of £100, £50 thereof to go to the expenses of the Court and £50 to the Board of Trade."

One other explosion may be referred to that arose from a tar boiler at Woolwich, killing 11 persons and injuring 6 others. This explosion is not peculiar. A similar one occurred at a chemical works at Miles Platting, on Wednesday, November 16th, 1879.

The recommendation given in the report for December last may be here repeated, viz., that some arrangement should be made for attaching safety valves to these tar boilers, and, if it is true, as sometimes stated, that safety valves, if applied to such boilers, would be very apt to get clogged, that every effort should be made to overcome the difficulty. The fatality attending this explosion, as well as that attending others of a similar character, shows that tar boilers as well as steam boilers should be included in any legislative enactment with regard to boiler explosions, so that such an Act should embrace not only explosions arising from steam boilers, but from boilers generally, provided that they are closed vessels and admitting of the generation of pressure.

ARUNDO DONAX FOR PARASOL HANDLES.

Of late years, a large trade has sprung up between this country and Algeria, in rough sticks, to be used for walking sticks and umbrella handles. Many plants producing stems useful for the above purposes have been introduced and cultivated expressly for exportation to this country. A few years since, when the *Eucalyptus* first attracted so much attention, it was grown very extensively in Algeria, and the young stems sent from thence into our markets to be converted chiefly into walking sticks. The rage for these, however, has died out, and sticks have been supplanted by newer productions, the most recent of which is the stem, with the rhizome attached, of *Arundo donax*, which have quite lately been imported largely into this country. These stems appear in the market under a new name, that of the "Nana" cane, a name derived from the circumstance that when they were first introduced they were supposed to be a species of bamboo, and not unlike the stems and rhizome of *Bambusa nana*; the specific name was thus taken up as the commercial name. The importer, Mr. Henry Howell, of Old-street, has converted these sticks into parasol and sunshade handles, and when trimmed and polished, the rhizomes, which form the knobs, have a unique and striking appearance, the natural colour being of a deep yellow. This has been taken advantage of by two wholesale manufacturers, Messrs. Long and Co., of Paddington-street, into whose possession the handles have passed, and who have produced an entire novelty in the parasols themselves, the covers being formed of rich brocaded silks of various tints, stretched over a framework of 16 ribs instead of the usual eight, all of which are gilded, producing an effect very similar to the now well-known Japanese paper umbrellas. Both the parasol and handle are unique, and are now to be seen in the shop windows of fashionable houses at the West-end of London.

NEW PROCESS OF SIMULTANEOUS COLOUR PRINTING.

Many have been the attempts so to combine the various pigments required for a polychrome print, as to reproduce them by a single impression, but the different densities and consistency of the pigments employed has hitherto found an obstacle to this desirable result. Mr. W. G. White, a member of the Society of Arts, has, after much time spent in experimenting, succeeded in forming such a combination of various chemicals with the colours he employs, as to render them, not only of uniform consistency, but also of the requisite hardness for the operations of cutting and combining to form the pattern desired. The prepared pigment chosen for the ground of the design is first run into a mould, so as to form a solid block, about three inches thick. The pattern is traced with a steel point upon a sheet of artificial talc, made with a mixture of collodion and oil, and this is pressed upon the block, so as to leave an impression of the lines upon its surface. The pattern is then cut out of the block by a sharp steel knife mounted on the end of an articulated parallelogram, so as to be maintained in a vertical position, while at the same time having a perfectly free horizontal motion. The various pigments forming the designs are then poured into the spaces cut out, a kind of mould being formed temporarily by a portion of the ground colour, supplemented by strips of wood soaked in water. The paint is poured in hot and liquid, and, as soon as it has cooled, another is added, and so on, until the whole design is finished, thus forming a complete mosaic. In the case of a large subject, various portions of the block may be executed by different operators at once, and then joined together; the method is also being tried, with every prospect of success, of cutting out the whole pattern in wood or metal, by means of a band-saw, and then forcing the die so formed into the block of ground colour, so as to stamp out the colour therefrom. The mosaic, or "type," as it is called, is put into a powerful press, resembling that used by lithographers, and is first shaved by a heavy steel knife, so as to render the surface perfectly flat, level, and smooth. The material to be printed upon is then laid face downwards on the slightly moistened block, and a series of rollers are passed over it once or twice, when the impression is found to have completely penetrated its substance. The print is exposed for a few seconds to the heat of a hot plate, for driving off the solvents employed, and perhaps fixing the colours, which are now found to be printed so permanently, that they will stand exposure to the sun, and wear only removes them in measure as the substance itself is worn away. As a crucial test, a piece of velvet printed in this manner has been boiled

for eight hours in strong potash solution, when it was found that the colour has not entirely disappeared. Water-colour drawings and oil paintings may be reproduced by this process, so as to present the appearance of chromo-lithographs and oleographs respectively. But there is a far more extended application, in printing upon textile fabrics the designs of Gobelins and Arbusson tapestry, to form curtains, *portières*, &c. The range of materials capable of being treated appears to be very extensive, as the writer saw the same design reproduced upon fine silk and the coarsest jute sacking, both impressions presenting all the necessary sharpness of outline. This process is now worked upon quite a commercial scale, and steam and hydraulic plant is being put up at Passy, Paris, to meet the demand created for cheap reproductions of artistic designs.

EDUCATION AND TRAINING OF THE CHILDREN OF THE POOR.

Dr. Mouat read a paper on the above subject, before the Statistical Society, on the 20th April, and stated his main object to be the training of the children, so as to make healthy men and women of them, to prevent their becoming in time the progenitors of a race more degenerate than themselves, as well as to fit them properly for the battle of life in the important class to which they naturally belong. All this with a view to depauperise them permanently, and thus to attack the evil of pauperism at its root, and to destroy the heredity which is at present a leading feature of the class.

After describing the state of the pauper schools, prior to the passing of the Poor-law Amendment Act of 1834, which showed them to be efficient instruments of evil with few redeeming qualities, and to be one of the chief recruiting grounds of juvenile criminals, the author proceeded to consider the various remedies which had been proposed to mitigate and remove the evils affecting a permanent body of some 30,000 or 40,000 children in England and Wales. He described the manner in which they are now dealt with, dwelling principally upon the schools still retained in workhouses, the separate and district schools, and boarding out. He condemned the former absolutely, on the ground that the atmosphere and associations of the workhouse are the worst to which a child could be exposed, at the most plastic and impressionable period of life, cardinal evils which good management failed to remove, and bad management tended to crystallise and render permanent in their evil influence.

Of the separate and district schools on the aggregate system, he spoke highly as to their educational influence, and their eminent success in dispauperising the children brought up in them. But he considered that they failed to deal efficiently with the physical aspects of the question, and to a lesser extent with its moral bearings, from causes inseparable from the collecting of large bodies of children together, and endeavouring, on the ground of economy, to develop their moral, intellectual, and physical faculties, with insufficient establishments, and in incurably unhealthy circumstances.

Taking as the basis of any successful system of educating and training children of all classes, the unit or individual as the most important factor, and the family system as that best fitted to contend successfully with physical and moral defects, Dr. Mouat strongly advocated breaking them up into smaller and more manageable bodies, and treating them on the cottage home or farm school system, which has been so successful on the continent of Europe, and in England, so far as it has yet been tried. Facts, figures, and arguments were employed to illustrate all of the above contentions.

Of boarding out Dr. Mouat disapproved, on the ground of general policy, that while it benefited the individual and was right in principle, it militated against sound economical laws, and was entirely opposed to a proper administration of the relief of destitution, being at the same time liable to inherent defects difficult to detect and prevent, and deplorable in their consequences.

CORRESPONDENCE.

INDIAN AGRICULTURE.

At last night's meeting of the Society of Arts, to which I had been invited to hear Mr. Robertson's paper on the "Agriculture of India," I was disappointed in not having had an opportunity of saying a few words in support of his views generally. A reference to my paper in the January, 1878, number of the Bengal Agricultural and Horticultural Society's *Journal*, on "Indian Famines," will show that I had already had occasion to cite Mr. Robertson's published reports of his experiments at the Government farm of Sydapet, in support of the view I had formed from the experience of my own farm operations in the Dehra Doon, on the exhausting effect on the soil of swamp cultivation—one of the most vital, yet disputed ,points in connection with Indian agriculture. I was prepared to adduce examples of my success in improving the quality of the indigenous products of the country, especially cotton, through the contrary method of dry cultivation and deeper tillage, and for which success, as testified to by professional reports on my produce by the Chambers of Commerce of Bengal, Bombay, and Liverpool, I was honoured with the acknowledgements of the Government of India, in the Agricultural Department, under Lord Northbrook's *régime*. Further, that selected seed from my estate was applied for, and always duly furnished by me, for distribution in the Court of Wards' estates, under the direct management of the Government officers. I was prepared to refer further to the farm operations of Mr. Phillips and Mr. Lloyd, the gentlemen in charge respectively of the Government farms at Allahabad and Amritsir, and then in a general review of all these isolated operations in different parts of the country, to submit my view that what was wanted to give practical effect to the whole in one system, was a Field Director-General of Agriculture, to move about on inspection tours through the several fields; to arrange for interchange of seed between remote districts; to collect reports, and periodically report progress and results to Government through the Agricultural branch of the Home, Revenue, and Agricultural Department, which would thus be invested with a precise and distinctive function, as a bureau of record and disbursement. A full discussion on the important subject of the meeting was what I had hoped for; and another gentleman, I afterwards heard, whose opinions would have carried weight, attended also on purpose to speak on the occasion. With all deference to Sir William Robinson, and his authority as chairman of the late meeting, I would venture to submit that his remarks do not point the way in which any improvement in the condition of India can be hoped for; for, to assert, even by implication, that its condition is not susceptible of improvement, in the face of the terrible famines sweeping periodically over the land, with ever increasing frequency and intensity, affording a presumption at once of bad agriculture and unsuitable taxation; of the people of affected districts succumbing at once and perishing by millions, proving the utter absence of vital resisting power, which an ordinarily well-fed and clothed population might be expected to present; with the country saddled with

special taxation for a famine insurance fund, which has been admitted by the authorities to be non-existent; and further, with the whole cost of the late and still dragging Afghan war, on the exhibition of a surplus which also is now admitted to be non-existent—with such apparent drawbacks to the condition of India, to assert that it is not susceptible of considerable improvement, is worse than idle. And I think it is at once paying the Queen a bad compliment, and doing great injustice to the sincere regard which her Imperial Majesty has ever evinced in the welfare of the people of India, to suppose that she can be flattered by such misplaced and ill-timed congratulations.

With respect to the alleged surplus in the Indian finances, I had strong reason to apprehend that there must be some great error, since, only so late as November last, a proposal which I had laid before Government on a matter of admitted public importance, connected with Indian Agriculture, the subject of last night's paper, was declined, on the ground of the then "present state of the Indian finances rendering it impossible for the Government to embark upon any such project." The appeal of the late Ministry to the confidence of the country having been based partly on their successful administration of the Indian finances, I thought it but just to all parties to warn the public to suspend their judgment on this point, in apprehension of the discovery of a possible error. Towards the latter end of March, then, I wrote a short article for a leading review, and, in forwarding it to the editor, ventured to express a hope that, although so late, space might yet be found for it in the forthcoming number of the review, on account of the opportuneness of the subject matter to the crisis of the dissolution. He informed me, in reply, that the arrangements for the forthcoming number of the review were already complete, and that he was unable to accept any addition to them. However, the true instinct of the nation has guided it, nevertheless, to a correct conclusion.

Not having had an opportunity last night of adding my mite of acknowledgments to Mr. Robertson for his suggestive paper, I should be glad to place on record at once my tribute to him, and my views generally on the subject of his address. I would have wished further to have paid my tribute of acknowledgments on the same occasion to the interest evinced, and the encouragement and support extended to my experimental farm operations in India by Mr. Cheetham, the founder and president of the Cotton Supply Association, by the late lamented Marquis of Tweeddale, and by Sir William Muir, late Lieut.-Governor, North-Western Provinces. Will you do me the favour, then, to submit this note to the approval of the Council, for insertion in an early issue of the Society's *Journal*.

C. L. Showers, Major-General.

Travellers' Club, May 8th, 1880.

NOTES ON BOOKS.

Eyesight: Good and Bad. By R. Brudenell Carter, F.R.C.S. London: Macmillan and Co. 1880.

According to the very short preface with which Mr. Brudenell Carter introduces his work, he is anxious to save the time of himself and his brother ophthalmic surgeons by inducing his patients to acquire for themselves the knowledge which he has often found it necessary to provide them with on a first visit. This book, therefore, is a purely popular account of the eye, in its normal condition, and in those various states of weakness which are known as long, short, and weak sights. The author begins with a chapter on the structure of the eye. Without entering into much anatomical detail, he gives an account of the eye such as any ordinary intelligent person could at once understand. In the second chapter, we have just so much optics as may enable the reader to understand the action of a lens, to the forms and properties of which the third chapter is devoted. We are now in a position to consider, in chapter four, how images are formed in the eye. The same chapter also deals with the acuteness and the field of vision, and finishes with an account of the curious blind spot which exists in all eyes. This account is illustrated with a diagram, by means of which the reader can prove for himself the existence of this blind spot in his own eyes. In the next chapter the reason of long and short sight is explained, and we are also shown by diagrams, and by a short explanation, how it is that a suitable lens so perfectly corrects either near or long sight. The explanation of the not uncommon defect of astigmatism follows this, and we then get an explanation of the power which the eye possesses of accommodating itself to the view of near and distant objects. Mr. Carter adds to this part of his subject a strong plea on behalf of spectacles, and vigorously opposes the popular prejudices as to the hurtful effects of convex glasses. The sixth chapter is an explanation of binocular vision. The seventh treats of defects of vision produced by faulty-shaped eyeballs, myopia, hypermetropia, and astigmatism. The last part of the subject is illustrated with a number of diagramatic letters, by means of which any person can ascertain for himself the existence of this defect in his own sight. Chapter eight deals with asthenopia, or weak sight. Chapter nine, after some remarks on colour and colour vision, goes on to discuss the subject of colour blindness, a subject which is daily attracting more attention. Mr. Carter describes the plan, now tolerably clearly admitted to be the only accurate one, invented by Professor Holmgren, to test colour vision by means of a number of skeins of different coloured wools. The examiner selects two or three skeins from the heap, and requires the person undergoing the test to match them. If he makes mistakes, his mistakes demonstrate, not only the fact of his colour blindness, but its nature. It is obvious that only some practical test of this sort can be of the slightest value, many of the so-called tests being simply questions of nomenclature, not of fact. Mr. Carter cannot, of course, devote much space to this subject, but he refers to the volume by Dr. Joy Jeffries, a review of which lately appeared in the pages of this *Journal*. The two following chapters are devoted to the care of the eyes, in infancy and adult age, amongst which will be found many hints as to lighting. In chapter twelve are discussed various inventions for saving visual effort, or, as it might be termed, economising eyesight. These include writing-frames for use in the dark, or when employing the eyes; the type-writer, &c. The concluding chapter contains practical hints on spectacles.

GENERAL NOTES.

Meat Bread.—M. Scheurer-Kestner has discovered this remarkable fact, that the fermentation of bread causes the complete digestion of meat. He found that a beef steak cut into small pieces, and mixed with flower and yeast, disappeared entirely during the process of purification, its nutritive principles becoming incorporated with the bread.

The meat would also appear capable of preservation for an indefinite period in its new state, for loaves of meat bread made in 1873 have been submitted to the French Academy of Science, when not a trace of worms or mouldiness was observable. At the beginning of his experiments, M. Scheurer-Kestner used raw meat, three parts of which, finely minced, he mixed with five parts of flour and the same quantity of yeast. Sufficient water was added to make the dough, which in due time began to ferment. After two or three hours, the meat has disappeared, and the bread was baked in the ordinary manner. Thus prepared, the meat-bread had a disagreeable, sour taste, which was avoided by cooking the meat for an hour with sufficient water to afterwards moisten the flour. The meat must be carefully deprived of fat, and only have sufficient salt to bring out the flavour, as salt by absorbing moisture from the air would tend to spoil the bread. A part of the beef may be replaced with advantage by salt lard, which is found to improve the flavour. The proportion of meat to flour should not exceed one half, so as to insure complete digestion. Bread made with a suitable proportion of veal is said to furnish excellent soup for the sick and wounded.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at Eight o'clock:—

MAY 19.—"Trade Routes between England, Norway, and Siberia." By Lieutenant G. T. TEMPLE. CLEMENTS R. MARKHAM, C.B., F.R.S., Sec. R.G.S., will preside.

INDIAN SECTION.

Friday Evenings, at Eight o'clock:—

MAY 14.—"China and the Chinese: their Early History and Future Prospects." By A. TERRIEN DE LA COUPERIE. Professor ROBERT K. DOUGLAS will preside.

FOREIGN AND COLONIAL SECTION.

Tuesday Evenings, at eight o'clock:—

MAY 18.—The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar." By the Rev. JAMES SIBREE, Jun., F.R.G.S. The Rev. G. P. BADGER, D.C.L., will preside.

APPLIED CHEMISTRY AND PHYSICS SECTION.

Thursday Evenings, at eight o'clock:—

MAY 20.—"Some Recent Advances in the Science of Photography." By Captain ABNEY, R.E., F.R.S.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 17TH...Asiatic, 22, Albemarle-street, W., 4 p.m. Annual Meeting.

TUESDAY, MAY 18TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Foreign and Colonial Section.) Rev. James Sibree, jun., "The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Fiske, "American Political Ideas."

Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m

WEDNESDAY, MAY 19TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Lieut. G. T. Temple, "Trade Routes between England, Norway, and Siberia."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Prof. E. Douglas Archibald, "Variations in the Barometric Weight of the Lower Amospheric Strata in India." 2. Mr. Charles Harding, "Winds and Weather experienced in the North Atlantic, between lats. 30° and 50° during February and March, 1880." 3. Mr. Charles N. Pearson, "The Meteorology of Mozufferpore, Tirhoot, for the year 1879." 4. For Exhibition:—The Radiometer invented by Mr. D. Winstanley.

Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. Henry Bradley, "Ptolemy's Measurements of South Coast." 2. Mr. C. W. Dymond, "British Earthworks, near Weston-Super-Mare."

THURSDAY, MAY 20TH...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Applied Chemistry and Physics Section.) Captain Abney, "Some Recent Advances in the Science of Photography."

Chemical, Burlington-house, W., 8 p.m. 1. Miss Lucy Holcrow and Dr. E. Frankland, "The Oxidation of Peaty Matter." 2. Discussion on Dr. Tidy's paper on "River Water."

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Third Conversazione.

Royal Institution, Albemarle-street, 3 p.m. Mr. T. W. R. Davids, "Buddhist Sacred Books."

Inventors' Institute, 4, St. Martin's place, W.C., 4 p.m. Annual Meeting.

Royal Historical, 22, Albemarle-street, W., 8 p.m. 1. Dr. Gustavus George Zerffi, "The Historical Development of Idealism and Realism, Part V.; Modern Period, Newton, Hume, Leibnitz, Wolf, Lessing, Fichte, and Kant." 2. Rev. Prebendary Irons, "The Reconstruction of the Civilisation of the West, from the Crowning of Charlemagne, A.D. 800, to the Ecclesiastical Concordat with the Empire, A.D. 1122."

Numismatic, 4, St. Martin's-place, W., 7 p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. C. H. Driver, "Cement Manufacture."

National Health Society, 23, Hertford-street, W., 4 p.m. Prof. E. Ray Lankester, "Germs: Unseen Enemies."

FRIDAY, MAY 21ST...Royal United Service Institution, Whitehall-yard, 3 p.m. Col. George G. Walker, "Our Militia, and How to Improve it."

Royal Institution, Albemarle-street, W., 9 p.m. Mr. W. Spottiswoode, "Electricity in *transitu*."

Philological, University College, W.C., 8 p.m. Anniversary. Annual Address by the President, Mr. J. A. H. Murray.

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "The Physiology or Functions of Plants." (Lecture III.)

SATURDAY, MAY 22ND...Physical, Science Schools, South Kensington, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "The Dramatists before Shakespeare."

ERRATA.—Page 548, col. 2, line 77 from bottom, *for* four millions of labourers, *read* a capital of £400,000,000; line 73 from bottom, *for* President, *read* several members.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,435. VOL. XXVIII.

FRIDAY, MAY 21, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday, the 16th of June. The cards of invitation will be issued shortly.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The annual Conference will be held on Thursday and Friday, the 10th and 11th June, 1880, at 11 a.m. each day, the Right Hon. JAMES STANSFELD, M.P., in the chair, assisted by the members of the Executive Committee :—Lord Alfred Churchill (Chairman of Council), F. A. Abel, C.B., F.R.S., Sir Henry Cole, K.C.B., C. N. Cresswell, Col. Sir E. Du Cane, K.C.B., Major-General Fred. Cotton, R.E., C.S.I., Capt. Douglas Galton, C.B., F.R.S., T. W. Keates, Dr. Voelcker, F.R.S.

It has been thought well that, at the Conference for the present year, the following subjects, suggested by previous Conferences, should be discussed. It must be understood that neither the Council nor the Executive Committee of the Conference express any collective opinion on the various points which they recommend as suited for discussion :—

I.—ADMINISTRATIVE ORGANISATION.

1. COUNTY BOARDS.—The necessity for further legislation with a view to develop and strengthen Local Government administration throughout the kingdom, especially by the constitution of County Boards. [*Vide* Resolution of Conference, May 24th, 1878, *Journal of the Society of Arts*, vol. xxvi., p. 737.]

a. That such County Boards, or combinations of them, should, *inter alia*, be charged with the conservation of rivers, including the prevention of floods, and the storage of water; and be empowered to put the Rivers Pollution Act of 1876 in force upon the complaint of any local sanitary authority, or other person aggrieved, and to charge the cost of the proceedings upon the County Rate, or to sanction proceedings of any sanitary authority, or of any such aggrieved person, for such purpose.

b. That such County Boards shall appoint County Health Superintendents in each county.

2. SANITARY DISTRICTS.—With regard to the local authorities of urban and rural sanitary districts, that they should be constituted the local governing body for all purposes for which their area is fit, thus enlarging and elevating their functions; and by entrusting functions requiring larger areas to groups or combinations of such districts.

3. ELECTION.—Election of members by ballot, instead of by voting-papers.

The holding of all local elections on one and the same day, so as to minimise the trouble and economise the time of the electors.

4. LOCAL GOVERNMENT BOARD INSPECTION.—The advisability of strengthening the administrative organisation of the Local Government Board, whilst diminishing centralisation and correspondence.

a. By mapping out England and Wales into a few large areas. Each area to be under the administration of a staff of inspectors, the whole under the superintendence of a permanent Head of the Department, properly assisted, and relieved of secretarial work.

b. By instituting an Inquiry Department, for the assistance of local authorities wanting information and applying for it, charged with the investigation of scientific processes, the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained.

II.—AMENDMENT OF THE LAW.

1. PUBLIC HEALTH ACT, 1875.

a. Amending section 229, by omitting all the words in the first part of the section down to the words "cost or that," and enacting as follows :—"When a local authority has made default in respect of any provisions of this Act, the Local Government Board shall, after due inquiry, make an order limiting a time for the performance of their duty, &c."

[N.B.—Under this section, as it now stands, the Government can intervene only when complaint by some person aggrieved is formally made, and not upon the report of their own inspectors, however flagrant the dereliction of duty. This amounts in the majority of cases, especially where the interests of the poorer inhabitants are concerned, to a defeat of the intentions of the Legislature altogether.]

b. By conferring powers, and corresponding duties, upon local authorities with regard to the construction of sewers, and connection of house drains therewith, as extensive as those conferred upon the Commissioners of Sewers by the 11 and 12 Vic., c. 112, ss. 37, 38, and 46. [*Vide* Mr. Alcock's Resolution, May 24th, 1878, *Journal of the Society of Arts*, vol. xvvi., p, 717.]

[N.B.—These compulsory powers will apply to *old* houses as well as *new*, and authorise the local authority to do the entire work of connections from the house to the main sewer at the cost of the owners by authorised contractors, after the same manner as gas and water companies.]

c. By amending section 23, and substituting one hundred *yards* for one hundred *feet*, and empowering the sanitary authority to prevent the continuance in old, and the construction in new, houses, of any drain, sewer, or conduit within the building until an outfall for emptying the same has been provided and constructed to the satisfaction of the authority, other than into any lake, pond, river, canal, or watercourse.

[N.B.—*Vide* "Model Bye-laws," Part i., memorandum; Part iv., s. 88.]

d. By enabling local authorities in rural districts to construct new sewers and water-supply works for the special service of outlying dwellings, and necessary for their healthful occupation, and charging the cost of the same upon the owners or occupiers thereof, payment to be made within a period not exceeding twenty-one years, the intent of such provision being that rates for sanitary purposes in rural districts, including water supply, should, as far as practicable, fall on those only who are benefited by the improvements.

2. Pollution of Rivers Act, 1876.—Amendments desirable in the Rivers Pollution Prevention Act, 1876. 39 and 40 Vic., c. 75.

a. By striking out of sections 2 and 3 the word "knowingly," as superfluous and embarrassing.

b. By striking out of sections 3 and 4, the words "solid" and "liquid" respectively, and by substituting, whenever necessary, the word "matter."

III.—Sanitary Inspection and Classification of Dwellings.

Discussion of the following resolution:—

"That it is expedient that the Metropolitan Board of Works within the metropolis, and the County Board within each county, should be empowered by the Legislature to make provision for the inspection and sanitary classification of dwellings, upon application being made by the owners thereof; and to grant certificates of healthworthiness in different categories, for terms of years, according to the perfection of sanitary equipment and fitness for habitation of such dwellings; and to determine the scale of fees to be paid for such inspection during construction and repair, and also upon delivery to the applicant of the certificate of classification awarded to such dwelling."

[N.B.—The conditions and mode of granting these certificates would be analagous to the practice of the department of "Lloyd's" Association in granting certificates of class and seaworthiness to the mercantile marine.]

IV.—Further Suggestions by Sanitary Authorities.

An Exhibition of Sanitary and other Appliances in connection with Water Supply, Sewage, and Health, will be held during the Conference. All articles for exhibition must be delivered, carriage free, at the Society's House, John-street, Adelphi, not later than Saturday, the 5th June, 1880. Manufacturers and others desiring to exhibit should communicate at once with the Secretary of the Society of Arts.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

An Examination for the above purpose will be held at the House of the Society of Arts during the week commencing 7th of June. There is no limit in respect to age, occupation, or position of the candidates. The examination will consist of three divisions, viz., for First and Second-class Certificates, and for Honours. Further particulars may be obtained on application to the Secretary, John-street, Adelphi.

INDIAN SECTION.

Friday, May 14th, 1880; Professor Robert K. Douglas in the chair. In consequence of the indisposition of Mons. Terrien de la Couperie, the paper, "China and the Chinese: their Early History and Future Prospects," announced for this evening, was not read. In its place, a paper on "Marco Polo" was read by Colonel Yule, C.B.

Mons. A. Terrien de la Couperie's paper will be printed in a future number of the *Journal*.

FOREIGN AND COLONIAL SECTION.

Tuesday, May 18th, 1880; B. Francis Cobb, Treasurer of the Society, in the chair. The paper read was "The Arts, Commerce, Recent Advances, and Future Prospects of the Island of Madagascar," by the Rev. James Sibree, Jun., F.R.G.S. This will be printed in a future number of the *Journal*.

SECTION OF APPLIED CHEMISTRY AND PHYSICS

Thursday, May 13th, 1880; William Spottiswoode, LL.D., Pres. R.S., in the chair.

The paper read was—

SOME OF THE OPTICAL PROPERTIES OF CRYSTALS.

By Professor W. Grylls Adams, F.R.S.

I have been asked to read a paper this evening on a most interesting and, from a scientific point of view, a most important subject; at the same time, it is one which requires close attention, and it is by no means easy in the short space of an hour to put a clear view of it before either a scientific or a popular audience. I will, therefore, at once ask you to give me your indulgence this evening, while I attempt to put before you and to explain some of the very beautiful effects which are produced on passing a beam of light through crystals.

By the optical properties of crystals are meant their transparency, their power of refracting or bending a beam of light, their lustre, their colour, and their phosphorescence.

Most of the crystals which we shall have to study this evening are as clear, or transparent, as the clearest plate-glass; and the clearer they are, the more beautiful are the effects which are produced on sending a beam of light through them. Many of these effects are due to what is called the interference of light, *i.e.*, the blotting out of one set of waves of light by means of another set of equal waves, just as one set of waves spreading over the surface of water may be blotted out by another set of equal waves going nearly in the same direction. Where the crests of the one set fall in the hollows of the other set, the particles of

water are pushed upwards and downwards at the same time, and then remain at rest. In all kinds of wave motion we have to deal with combinations of waves and with their interference. Thus, in sound, the vibrations from two successive sections of a vibrating plate combine with one another, and they may be made to reinforce, or to interfere with one another by means of a sector revolving over the disc; in this way we may get beats which are the result of damping some of the vibrating segments. We may also get interference from the two prongs of a tuning fork. In the same way, two equal beams of light going nearly in the same direction may interfere at certain points in their course, and produce total darkness. This interference takes place along certain lines, so situated that the difference of distance from the two sources to every point on the same line remains the same. Between these lines the waves from the two sources reinforce one another, just as the waves of water —two crests or two hollows—come together, and make a larger wave.

In the case of light, this interference may be produced by bringing a curved surface of glass, such as a lens, in contact with the face of a mirror, and reflecting a beam of light from the mirror. The light will pass backwards and forwards between the lens and the mirror, some of it getting out at each reflection, and the illumination on a screen placed opposite will result from the overlapping of these several waves from the successive reflections. We shall get one set of waves retarded behind another set, because of the increase in the length of path due to the successive reflections. The interference bands will in this case be ranged round the image of the point of contact of the lens and mirror. They are called Newton's rings, because they were first investigated by Sir Isaac Newton.

It will be seen that the colours going out from the centre are violet, blue, green, yellow, orange, red, and that these colours are repeated in the same order; so that, for each colour, there are successive interference bands. Now, according to the wave theory, the size of an interference ring increases with the length of the wave, and as the length of a wave of violet light is shorter than the length of a wave of red light, the violet rings are smaller than the corresponding red rings.

Another very beautiful way of producing interference bands is by reflecting a beam of light from a steel mirror, on which parallel lines have been ruled with a diamond. When these lines are very close together, the waves of light which are reflected from the successive spaces between the lines interfere with one another, and produce interference bands upon a screen. The nearer the ruled lines are to one another on the mirror, the wider the interference bands will be apart, and the greater the separation between the colours. Hence, by means of lines ruled very close together, we may get the interference spectrum spread out over a considerable length of the screen. A mirror so ruled with equidistant parallel lines is called a diffraction grating.

I have here such a steel mirror sent to me by Mr. Rutherfurd, of New York, on which there are 17,296 lines ruled to the inch, by means of which very beautiful spectra may be obtained. As in Newton's rings we get successive rings of the same colour, so in Rutherfurd's diffraction grating we get successive spectra, in which the colours are more dispersed or separated from one another as we go outward. These interference bands may also be obtained by passing a beam of light through a glass plate on which a photograph of a diffraction grating has been taken. I have here a photograph of a grating with 3,001 lines ruled to the inch, from which we may obtain the successive spectra corresponding to Newton's rings of successive orders. As there is only about one-sixth of the number of lines on the grating, the length of the spectrum and the separation between the spectra will only be about one-sixth of the length and separation of the spectra in the Rutherfurd grating with 17,296 lines to the inch.

The iridescent colours produced in the soap bubble, or by breathing on glass, or by scattering a very fine powder, such as lycopodium or as the spores of the truffle on the surface of glass, are due to interference; and the beautiful colours on mother-of-pearl and oyster shells arise from the interference of the light reflected from successive edges of the thin layers of which the shell is made up.

Many varieties of fluor spar and diamond are phosphorescent, and I had intended to include in this lecture an account of some of the beautiful effects of phosphorescence, but this subject was so clearly and so attractively put before you a short time since by Prof. Heaton, in his paper on "Balmain's Luminous Paint," that I may now pass over it very lightly. It is very easy for anyone to make an experiment on phosphorescence, and to convince himself of the phosphorescence of crystals. Taking a lump of sugar into a dark room, and staying a short time to allow the pupils of the eyes to become sensitive, he will find, on breaking the lump of sugar, that it gives out a glowing or phosphorescent light.

Of the cause of the lustre of crystals, or of their colour, produced by their unequal absorption of different kinds of light, I propose to say very little this evening. On this subject I would only draw attention to the fact that the colour of many crystals change when they are viewed by light passing through them in different directions. Such crystals are called dichroic, or pleochroic, if they give more than two colours. We gain some insight into the cause of this dichroism, when we examine the light which has passed through them by sending it through a crystal of Iceland spar, which has the remarkable property of splitting up a beam of light into two distinct beams. On passing a beam of white light through a crystal of Iceland spar, it is split up into two beams of white light of equal intensity, but if a light be first passed through a dichroic crystal, and then through Iceland spar, the two beams of light formed are found to be of two distinct colours. I have here some dichroic crystals, which have been grown by Mr. John Thomson, and in these this dichroism is very distinctly shown. It will be seen that the colour of the images depends upon the relative position of the dichroic crystal and the Iceland spar, for on turning the crystal round, the image changes colour.

This action of Iceland spar on a beam of white

light, by which two beams of white light are produced, brings me to the principal subject of this evening's lecture, the double refraction and polarisation of light by crystals.

The six systems of crystals, which are distinguished from one another by their forms, may be reduced in number to three when we consider simply their optical properties. Crystals of the cubic system—to which belong alum, common salt, the diamond, and many of the elementary bodies—refract light singly in the same way and according to the same laws as glass or water, and hence we may conclude that the waves by which light is transmitted in these crystals travel with the same velocity in all directions within the crystals. These crystals of the cubic system have equal degrees of elasticity in all directions. They have not the power of splitting up a beam of white light into two separate beams, but refract it as a single beam, so that one of these crystals cut with parallel faces acts on a beam of light in the same way as a piece of plate-glass. We see that the diamond, which belongs to this system, has not the power of double refraction Crystals of the square-prismatic or pyramidal system, and of the rhombohedral or hexagonal system, have one optic axis which coincides with the principal axis of the crystal. When light passes through them in the direction of this axis, it is refracted singly according to the ordinary law of refraction for glass or water, but when a ray of light passes through them in any other direction, they divide it into two rays, which pass in different directions through the crystal. One of these rays is refracted according to the ordinary law of refraction, and the other is refracted according to a different law. These rays are called the ordinary and the extraordinary rays, and it will be seen that when the crystal is rotated, one of these rays revolves around the other.

Ice, talc, mica, tourmaline, and Iceland spar belong to the rhombohedral system, and these crystals have one optic axis coinciding with the principal axis of the crystal. They are called uniaxal crystals. According to the wave-theory, the wave corresponding to the ordinary ray spreads equally in all directions in the form of a sphere, but the wave corresponding to the extraordinary ray spreads with different velocities in different directions; its form is that of a spheroid, either oblate—*i.e.*, a sphere, flattened towards the poles like the earth—or prolate—*i.e.*, elongated in the direction of the poles. The wave for the extraordinary ray is of the form of an oblate spheroid, like the earth, in the case of mica and Iceland spar, and of the form of a prolate spheroid in ice, zircon, quartz, and some other crystals. The polar diameter of the spheroid is the optic axis of the uniaxal crystal, and in most crystals the two waves spread with the same velocity in the direction of this axis.

This is the case with Iceland spar, which may be taken as a type of uniaxal crystals. As we shall presently see, in quartz the two waves spread with unequal velocities even in the direction of the axis, so that the spheroid for the extraordinary ray lies entirely inside the sphere for the ordinary ray. There are other peculiarities of quartz to which I shall presently have to refer.

Let us consider now the action of Iceland spar on the two beams of light passing through it. These beams proceed from the same point in different directions through the crystal, showing that they have different indices of refraction, or that one goes faster than the other. The slowest in Iceland spar is the ordinary ray, and that is most refracted or bent on entering. The crystal may be cut so that this ray may fall on the plane of section at so large an angle that it will be totally reflected and not get through at all, whilst the extraordinary ray will fall on the plane of section at a smaller angle of incidence, and may get through. Thus we get only one of these two rays. This is the arrangement of Foucault's prism.

If the prism be cut at a different angle, and the parts cemented together with Canada balsam, then this Canada balsam reflects the ordinary ray, and allows the extraordinary ray to pass through. This is the arrangement in the Nicol's prism. For the same size, the Nicol's prism has the disadvantage of being longer, but it also has great advantages over the Foucault's prism. We get here only one of the two rays, and we shall find that it differs in character from a beam of ordinary light. It has been changed in passing through the Nicol's prism, in such a way that it cannot get through a second Nicol's prism, when the principal planes of the two prisms are placed at right angles to one another. It has a distinct relation to the principal plane of the Nicol's prism, through which it has passed; and without positively stating that such is the case, I would say that the investigations of those who have most fully considered the subject seem to show that the vibrations, by which this extraordinary ray passes through the Nicol's prism, take place only in the principal plane of the prism. If then the ray is passing horizontally, and the principal plane of the Nicol's prism is vertical, the vibrations for the extraordinary ray take place *in* vertical straight lines. All investigations show that whatever relation holds between the extraordinary ray and the principal plane of the crystal, the same relation must hold between the ordinary ray and a plane perpendicular to the principal plane. In a crystal of Iceland spar, with its principal plane vertical straight *down* the room, the vibrations for the extraordinary ray will be up and down in vertical straight lines, and the vibrations for the ordinary ray will be in horizontal straight lines *across* the room; in both cases the vibrations are at right angles to the direction in which the ray is going.

From the relation of the vibrations for these rays with regard to particular planes, they are said to be polarised, and a beam which is transmitted by vibrations, which take place always in the same plane, is called a beam of plane-polarised light. The Nicol's prism which produces this effect is called a polariser.

We have other means of producing plane-polarised light. If instead of Iceland spar we take a crystal of tourmaline, we get only one ray, but on examining it in the same way as we examined the beam polarised by the Nicol's prism, we find that when the principal plane of the tourmaline is at right angles to the principal plane of the examining Nicol's prism or analyser, no light is allowed to pass through. We see then that the tourmaline

and the Nicol's prism produce the same effect when their principal planes are parallel, so that tourmaline only allows the extraordinary ray to pass through. We may see that two tourmalines, with their axes at right angles, will allow no light to pass through. The vibrations transmitted by the first tourmaline are stopped by the second. Thus we may use two tourmalines; one as a polariser to produce a beam of plane-polarised light, and the other as an analyser to examine it.

Now let us study, by means of polarised light, the effects produced by crystals and other bodies, which may give us some idea as to their different degrees of elasticity in different directions. We may make use of models to give clearer ideas as to the action of these crystals on a beam of light.

A beam of light, before entering the crystal, is transmitted by means of vibrations in every direction, at right angles to the direction of the beam; when it enters a double refracting crystal, the vibrations take place in two planes, at right angles to one another, and, on emergence, we have two plane-polarised beams. Another model will show the action of the tourmaline on a ray of common light. The ordinary ray is stopped, and only the extraordinary ray is allowed to pass through. The vibrations are represented as taking place in a vertical plane, *i.e.*, parallel to the principal plane of the tourmaline, and these are stopped by the second tourmaline, which has its principal plane horizontal.

When we place a plate of a doubly-refracting crystal, such as selenite, between two Nicol's prisms, with their axes crossed, no change will be produced by the selenite so long as its principal plane coincides with the principal plane of either of the Nicol's prisms, but if the selenite be turned, light passes through, and the field becomes brighter and brighter, until the selenite is turned through an angle of 45°. With a thin plate, the light is coloured, the colour depending on the thickness of the plate. Now, keeping the selenite fixed, and turning the analyser, the brightness of the beam diminishes, until when the analyser has been turned through 45°, the colour vanishes. On continuing to turn the analyser in the same direction, the field will again become coloured, but with the complementary colour. If we make use of a double image prism for an analyser, we get two images which are of complementary colours, so that where they overlap we have white light.

In the thickness of the selenite plate, one wave is retarded behind the other by a distance, which is half a wave length for one given colour, hence the two waves corresponding to that colour interfere or blot one another out, and the remaining light gives the complementary colour. In the spectrum of the light, when analysed, there will be a dark band in the position of the colour blotted out by the interference. The reason why the two images are complementary will appear thus:—Suppose a principal plane of the first Nicol's prism vertical. Let the principal plane of the selenite be inclined at 45° to the vertical, so that the vibrations take place in two planes each, inclined at 45° to the vertical, the vibrations taking place in these inclined planes will be upwards and outwards together. Now, as far as they are both upwards, they reinforce one another, and as far as they are both outwards at the same time, they oppose one another, hence the waves which come out, reinforcing one another, when the analyser has its principal plane vertical, oppose one another and interfere when the principal plane of the analyser is horizontal. As colour depends upon wave length, the colour which is strongest in the first position of the analyser is entirely wanting in the second position. The particular colour which is blotted out depends on the difference of retardation of one wave behind the other in the thickness of the selenite, and hence the colour depends upon the thickness. If we take a lens of selenite which is thinnest at the axis, we get coloured rings, due to the interference of the successive colours. If different plates of selenite be placed over one another, so as to give different thicknesses in different parts, there will be a change of colour wherever the thickness changes. In consequence of this, coloured pictures of objects may be produced by placing different thicknesses of selenite on glass plates, and adapting the thickness properly to the colour of the various parts of the object.

If we use a wedge of selenite, there will be a gradual change in the colours from the violet to the red end of the spectrum, arising from the increase in the thickness causing the interference of the successive colours in going away from the edge of the wedge.

Some beautiful effects are produced by employing two wedges of selenite with the axis of one parallel, and the other perpendicular to the thin edge, and placing them over one another in different positions.

We may illustrate several characteristics of the passage of waves of light through crystals, by means of three strings, of different sizes and lengths, attached to one another at a point, and stretched by different weights, so that each of them will vibrate in unison with a tuning-fork, to which one of them is attached. The tuning-fork will set the first string in vibration; the waves arriving at the junction with the other strings, will set the denser strings in vibration, provided their tensions and directions are properly arranged, their lengths being proportional to the velocities of the waves along them. Thus, the passing of the wave, from the thin string to two other thicker strings, represents the wave of light entering a crystal and dividing into two waves, which proceed in different directions through the crystal with different velocities, the velocity in a given direction depending on the elasticity or tension in that direction; thus one wave may be retarded behind the other. The difference in length represents the retardation, and to this is due the interference of the light, and the production of the coloured bands in selenite or other doubly-refracting crystal. By means of smooth guides, the thick vibrating strings may be made to vibrate in planes at right angles to one another to represent the vibrations of two plane-polarised beams of light. The action of a Nicol's prism or analyser may be represented by continuing the strings, and again joining their ends to the end of a thin string equal to the first, and controlling its vibrations by means of a guide representing the position of the principal plane of the analyser.

Now, let us examine the effects due to interference when a beam of light passes through uniaxal crystals, which are cut perpendicular to the optic axis. We shall see that, in two planes at

right angles to one another (the principal planes of the polariser and analyser), the darkness still remains on inserting the crystal, so that there is a black cross; but in other parts of the field, which are illuminated by rays which have passed somewhat obliquely through the crystal, the difference in the retardation of the two beams gives rings of interference, just as in Newton's rings, with the colours arranged in the same order, depending on their wave lengths, the shortest being those which are nearest to the centre. This is the appearance presented by all uniaxal crystals, the size of the rings being greater as the thickness of the crystal diminishes.

In the three remaining systems of crystals, the right-rhombic, the clino-rhombic, and the anorthic, there are two optic axes. Suppose a crystal cut perpendicular to the line bisecting the optic axes. When the plane of the two optic axes coincides with the principal plane of either the polariser or analyser, when they are crossed, there will be a black cross; but in other parts of the field the forms of the interference rings will be modified by their relation to the two optic axes, and will be curves called lemniscates.

When the crystal is turned in its own plane, the points for which the vibrations are parallel to the principal plane of the polariser, or analyser, will lie on hyperbolas passing through the two optic axes. In all other parts of the field there will be coloured rings and lemniscates indicating the lines of interference of the several colours. These phenomena of polarised light are very difficult to describe, and the exhibition of a few crystals cut either perpendicular to the line bisecting the angle between the optic axes, or perpendicular to one of the optic axes, will show the forms of the rings, and reveal some of the most beautiful effects of the interference of polarised light.

Quartz is a uniaxal crystal, which is entirely exceptional. When it is cut perpendicular to the axis, the black cross does not pass through the centre of the field, but within the rings the field is of one uniform tint, the tint depending on the thickness of the crystal. This arises from what is termed rotatory polarisation; and we regard the vibrations as being transmitted by the successive motion of adjoining particles in circles, the two waves transmitted with different velocities by means of right-handed and left-handed circular motions giving a plane wave. That a wave may be transmitted by the circular motions of the particles is readily shown by Powell's wave machine. We may have right-handed rotation where the particles move over from left to right, like the hands of a watch, or like a corkscrew; and left-handed rotation when they move over from right to left, as the wave progresses away from the observer. Now imagine two sets of waves formed by circular motions in opposite directions existing together, the particles in one set performing a complete rotation quicker than those of the other.

We shall get from this some idea of the transmission of waves through quartz, in the direction of the optic axis. The waves are transmitted with different velocities. In consequence of this, on coming out of the crystal, the two sets of opposing circular motions are combined in the Nicol's prism into a radial motion, giving a plane-polarised beam, the plane of the vibrations being inclined either to the right or left of the principal plane of the polariser by an angle depending on the retardation of one of the rays behind the other. The rotation of the plane of polarisation depends on the interval of retardation, and, therefore, is different for the different colours. The rotation also depends on the thickness; so that, for the same position of the analyser, the colours will be different for different thicknesses. The rotation of the plane of polarisation is greatest for the more refrangible rays; so that, in a right-handed crystal, we get the colours red, orange, yellow, green, blue, and violet in order, on turning the analyser from left to right, supposing we are looking in the direction in which the light is going.

A corkscrew is right-handed, the light being supposed to be going away from the observer. Some crystals of quartz are right-handed and others left-handed, and if two such crystals of the same thickness be placed side by side in the field, they will be of the same tints when the Nicol's prisms are parallel, or when they are crossed at right angles, but on turning the analyser from one position to the other, the colours will change in opposite directions in the two crystals. On turning to the right, the colours will change through red, orange, green, blue, &c., in the right-handed crystal, and through violet, blue, green, orange, &c., in the left-handed crystal.

By a slight modification of these crystals, we may get bands through the field, which are continuous when the Nicol's prisms are parallel or perpendicular, but which travel in opposite directions across the field, when the analyser is turned. It is found that certain liquids have this power, which is possessed by quartz, of rotating the plane of polarisation. Almost the only means of distinguishing between tartaric acid and racemic acid is by their different powers of rotatory polarisation. Most of the essential oils rotate the plane of polarisation. Oil of turpentine rotates the plane of polarisation in one direction, whilst oil of lemon and solutions of cane sugar and glucose rotate the plane of polarisation in the opposite direction. Cane sugar and uncrystallisable sugar rotate the plane in opposite directions. The strength of solutions of these substances may be measured by the amount of rotation. In sugar refineries, this property of rotating the plane of polarisation is made use of to distinguish different kinds of sugar, and to determine the strength of such solutions. The instrument used for the purpose is called the saccharimeter. The biquartz is made use of to detect with greater certainty the amount of rotation of the plane, and a left-handed rotation produced by the liquid may be balanced by an opposite rotation produced by a right-handed quartz plate of proper thickness, and the rotations of different liquids may be so compared.

In the saccharimeter, a more delicate arrangement than an ordinary biquartz is employed, so as to give more minute changes of position of the analyser. Two plates of quartz, cut at an angle of 45° to the axis, and crossed so as to give interference bands, called Savart's bands, are sometimes employed as in this saccharimeter. Sometimes two quartz wedges, crossed and so arranged that one can slide over the other, are employed, so as to give rapid changes of colour for slight motions of the analyser, the object being to determine as

exactly as possible the change of position of the plane of polarisation of the beam of light.

A very beautiful and very delicate effect is produced by crossing over one another two plates of quartz, and according to the relative positions of the crystals and the angles at which the plates are cut, we may get a series of ellipses, or straight lines, or hyperbolas.

Endless varieties of arrangements may be made by varying the thicknesses and positions of quartz wedges placed over one another. With one arrangement, we may cause the series of hyperbolas to change their positions as we shift one of the pieces over the other.

In conclusion, I must thank the President of the Royal Society for presiding this evening, and must apologise to him for bringing forward experiments with which he is already familiar, and which he is so much better able than myself to put before an audience. I must also thank you for your kind attention whilst I have tried to compress into one lecture what might far more easily be spread over a course of considerable length.

DISCUSSION.

The Chairman said that, before proposing a vote of thanks to Professor Adams, he desired to express his own individual admiration of the manner in which the subject had been handled. It was one which was full of difficulties in explanation, because it referred to a set of phenomena with which people's eyes and heads were by no means familiar. They required special instruments to bring them out fully into visible existence, and these instruments were not accessible to everybody. Professor Adams had covered a remarkable range of his subject, for it was one which ramified out into a great variety of directions, and everyone who had experimented on the subject knew into how many bye-paths he was led by the various fascinating combinations which suggested themselves as he went on. One criticism only he would venture to offer on the paper, viz., that Prof. Adams had omitted to mention two points, to which he was very glad to have the opportunity of calling attention. One was in reference to the curious and difficult experiment of showing the effect of oblique rays of crystals, namely, those rings and brushes which had been so beautifully thrown on the screen. Professor Adams had omitted to mention that the success with which he was able to bring so large a portion of these curious phenomena into the field at once, was due to the instruments he had made use of, one of which was his own invention. He had notably increased the power of the polariscope of that kind, by a combination of lenses which was due to his own ingenuity. The second point referred rather to the practical applications of this subject, which, as had been truly said, were very few. Besides the application to saccharimetry, there was an application of this subject to the very diffierent field of knowledge, viz., that of celestial physics. In the rare and interesting phenomenon of a total solar eclipse, there came out an appearance called the solar corona, a sort of comparatively feeble light which surrounded the sun far away in the upper regions of its atmosphere. One of the very few means we possessed of ascertaining the nature of this corona was the polariscope. By the application of this instrument to the phenomenon during the brief interval when it could be seen at all, astronomers had been able to determine in the first place whether it was a true solar phenomenon, or whether it was one due only to the glare of our own atmosphere. That question had been determined in favour of the sun, and, furthermore, several other features had been ascertained by means of the same instrument. The omission of this point by Professor Adams might probably have been due to the fact that this was another branch in which he had himself added considerably to our share of knowledge. In a paper published in the *Philosophical Magazine*, he had given some mathematical calculations by which astronomers had been able to determine in a remarkable degree the amount of effect due to solar polarisation, and the amount due to our own atmosphere, for it was not a simple but a very complex subject. Professor Adams had himself taken part in one of the expeditions to view a total solar eclipse some years ago, and on that occasion he and others made use of the theoretical considerations of which he was himself the author. With these two exceptions, he could not conceive of any other points which could have been brought within the range of a single paper, and the Society was much to be congratulated on the amount of information brought together and laid before them in so short a space of time. He begged, therefore, to propose a cordial vote of thanks to Professor Adams for his paper, and for the admirable manner in which he had illustrated the subject.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 19th, 1880; CLEMENTS R. MARKHAM, C.B., F.R.G.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Broome, Joseph, Wood-lawn, Didsbury, Manchester.
Drake, Sir William Henry, K.C.B., 15, Clanricarde-gardens, W.
Jenkinson, Henry Irwin, Keswick, Cumberland.
Maignen, Prosper Auguste, 22, Great Tower-st., E.C.
Severn, Henry Augustus, F.R.G.S., 192, Earl's Court-road, S.W., and Devalah, India.
Wigham, John Richardson, Albany-house, Monkstown, Co. Dublin.

The following candidates were balloted for and duly elected members of the Society:—

Adams, Wm. Alexander, Walford Manor, Shrewsbury.
Allhusen, Alfred, Gateshead-on-Tyne.
Aveling, Thomas, Boley Hill-house, Rochester, Kent.
Beckingsale, George, Ferndale, Wanstead, Essex.
Bridge, Frederick A., 207, East India-road, E.
Clay, Sir Arthur T. F., Bart., Barrows-Lea, Shere, Guildford, Surrey.
Davison, Charles Edward, Trentham-house, Twickenham-park.
Marshall, William, F.R.G.S., 37, Norfolk-street, Strand, W.C.
Marston, Edward, 19, Highbury-crescent, N.
Matheson, Hugh Mackay, 3, Lombard-street, E.C.
Rees, Thomas Henry, 196, Westminster-bridge-road, S.E.
Schmidt, Conrad Marshal, 49, Kingsdown-road, Upper Holloway, N.
Utley, Samuel, 10, Norfolk-place, Halifax, Yorks.

The paper read was—

TRADE ROUTES BETWEEN ENGLAND, NORWAY, AND SIBERIA.

By Lieutenant George T. Temple, R.N., F.R.G.S.

The first voyage known to have been made from England to the head of the White Sea, was undertaken in 1553, at the instigation of some merchants of London, who formed a company to send out ships "for the search and discovery of the northern

part of the world, to open a way and passage to new and unknown kingdoms." Sir Hugh Willoughby, who commanded the expedition, perished with the crews of two of his ships at the mouth of the River Varsina; but the third ship, which parted company with the others off the North Cape, was attended by better fortune. She was commanded by Master Richard Chancelor, who, although earnestly dissuaded from prosecuting his voyage farther by "certaine Scottishmen" at Vardo, was determined "either to bring that to pass which was intended, or else to die the death." Accordingly, he made his way safely to the mouth of the Dwina, travelled overland to Moscow, and inaugurated a commerce with Russia, which has continued ever since. This expedition was followed by the voyages of Burrough, Pet and Jackman, Barentz and Hudson, whose purpose was "to passe by the mouth of the River Ob, and to double that way the North Cape of Tartaria, or to give reason wherefore it will not be." But these brave old heroes were baffled by the ice, and Hudson returned to England in 1608, "out of hope to find passage by the north-east." The question of the north-east passage to far Cathay was revived by Captain John Wood, in 1676, but he lost one of his two ships on the west coast of Novaya Zemlya, and returned without making any discovery. "With Wood's failure," says a learned writer, "seems to have closed the long list of unfortunate northern expeditions in that century; and the discovery, if not absolutely despaired of, by being so often missed, ceased for many years to be sought for." The grand project of Peter the Great for tracing the whole northern coast of Asia, from Archangel to Kamchatka, was carried out after his death in the last century; but none of the Russian explorers succeeded in doubling Cape Chelyuskin. Their efforts were followed by another long period of inaction; but, quite recently, the voyages of various Norwegian seal and walrus hunters, of Captain Wiggins, and of Professor Nordenskjöld, again drew general attention to the possibility of establishing a regular trade between Europe and the rivers of Siberia. This subject was ably dealt with a short time ago by Mr. Henry Seebohm, himself a distinguished Siberian traveller; so I shall only observe, in passing, that Siberia has been declared by M. Ferdinand de Lesseps to be the richest country of the whole world in respect of the produce of the animal, vegetable, and mineral kingdoms. This estimate will hardly appear to be overdrawn, when we consider the abundance and variety of the products which Siberia is capable of supplying—gold, silver, copper, iron, graphite, and coal, fossil ivory, timber from boundless forests, wheat and other vegetable produce from illimitable plains of the most fertile soil; in course of time even wines from the warm southern regions, furs from the cold region, wool, tallow, and meat from the grassy plains—the meat preserved fresh by simple exposure to the severe cold of winter—and finally, fish of the finest quality in extraordinary numbers.

The successes of these later voyages, and the incalculable importance of finding an outlet for the pent-up wealth of Northern Asia, led to the conception of the most memorable enterprise of modern times, an enterprise not rashly undertaken in the hope of winning notoriety, but carefully planned on the basis of sagacious inference approved by known facts. The North-East Passage was once more attempted; the northernmost point of the Old World was doubled by two Swedish steamers, and the twin continents of Europe and Asia were circumnavigated for the first time by the illustrious Swedish professor, Baron Nordenskjöld. Inspired, no doubt, by this brilliant achievement, a Russian writer lately described in glowing colours the vast resources of Siberia—"the golden land"—and recapitulated the advantages likely to follow upon the opening of a new commercial water-way between European ports and Siberian rivers. He then cheerfully observes that "the way is now found, the road is clear;" and he finally gets "packed" in the Kara Sea, which, he asserts, is navigable for "ten months in the year." This is a harmless, and, no doubt, honest delusion; but the bit about the road is more serious, because it has been repeated and believed. With almost equal justice, we might say that "the road is clear," because Cameron and one or two others "found the way" across Africa.

It seems, however, to be the general fashion, when discussing trade routes between England and Siberia, to ignore some 1,200 miles or so of the exposed and dangerous coast of Norway, which must, nevertheless, be passed by vessels bound either to or from Siberia by way of the Kara Sea. There are several points to be considered besides, but geography, like charity, begins at home, and this one is the nearest to our own seaboard.

The general features of the Norwegian coast are now pretty well known, still, it may not be out of place to give a rough sketch of them here. The whole coast, with one or two insignificant exceptions, is rocky, steep, and very irregular, being deeply indented by numerous fiords, or arms of the sea. On the south-west coast the character of the scenery is monotonous, and is comparatively low and tame; it increases in interest and variety towards the north, and, between Trondhjem and Hammerfest, presents a scene of savage grandeur, which is perhaps only rivalled by the coast of South Greenland or the Straits of Magellan. The north coast is distinguished by table-topped, precipitous headlands about 1,000 feet high, of which the North Cape is a good example, but decreases in height and boldness of outline to the eastward and southward. The west and north-west coasts are skirted by a deep range of islands, interspersed with undulating clusters of low, rounded, rocky islets, which often lie in long rows nearly parallel to the coast. Many of the larger islands rise abruptly from the sea to the same elevation as the mainland, or from 2,000 to 4,000 feet; the smaller ones vary in size, from mere rocks to islets 100 feet high, and extend to a distance of 10 to 30 miles from the mainland. The channels between these islands and rocks form the wonderful inshore route called the "Inner Lead," which continues with few interruptions from the Naze to the North Cape, and in many places is so completely landlocked that it has been compared to a chain of lakes. Some of the passages in the Inner Lead are so narrow and intricate that they should not be attempted by square-rigged vessels, except with a leading wind; but for steamers and fore-and-afters this route is generally both safer and more con-

venient than the open sea, while its numerous anchorages afford refuge in cases of emergency.

Now it will probably be found that the greatest results in trading with Siberia are to be obtained by three vessels working together. Two fast steamers of light draught, properly equipped for ice navigation, would run between the mouths of the rivers and some convenient entrepôt, such as Vardö, where the third and largest ship would receive their cargoes of Siberian products, and fill them up again with coal and European goods for their second trip. On the outward and homeward voyages, the steamers would certainly save time, and much wear and tear, by taking the "Inner Lead;" but should the depôt ship be a sailer, she would probably take the outside passage. In this case, it would be most important that she should be supplied with reliable charts and sailing directions, for the coast of Norway is a terrible lee-shore during the north-westerly gales which prevail between autumn and winter, and many a gallant ship has gone down, simply because the channels leading through the fringe of outlying rocks to secure harbours are unknown to foreigners. Vessels taking the "Inner Lead" would of course take native pilots; but pilots, like other mortals, are fallible, and the charts and directions would be required in this case also. It will be remembered that, in 1878, the steamer *Louise*, one of the first vessels engaged in the new Siberian trade, after it was opened by Wiggins and Nordenskjöld, was stranded on her way to the Yenisei in a narrow and dangerous strait called Brönösund, well-known to travellers on account of its vicinity to the curious natural tunnel through Torghatten. This not only proves the truth of what I have just said, but is a striking example of the disasters arising from deficient hydrographical knowledge. Here, as on many other parts of the Norwegian coast, there are several nearly parallel channels, and the pilots, if left to themselves, will generally take the one frequented by coasters, though, as in this case, it may be the most dangerous of all. Had the *Louise* kept a little to the westward, she would have found a clear, open passage, and safety would have been insured at the trifling cost of half an hour's extra steaming. Vessels trading to the White Sea—and it must be remembered that the White Sea trade is of considerable importance—are, of course, exposed to the same risks on the coast of Norway as those bound to Siberia.

With the British portion of the North Sea we are naturally acquainted; the White Sea is also surveyed, and the Russian Government has already taken measures for surveying and buoying the mouths of the Ob and Yenisei, while the movements of the ice and the state of the water in the Kara Sea, during the summer and autumn, may now be considered as fairly tabulated. To this it may possibly be objected that several vessels were unsuccessful last season, but that was chiefly due to the want of local experience on the part of their captains—in some measure also to their late arrival in the Barentz Sea. The Norwegian schooner *Nordland* reached Jugor, or Pet Strait, as early as the 12th of July, and afterwards cruised about the Kara Sea in every direction, meeting with no interruption from the ice worth speaking of. Other Norwegian seal and walrus hunters tell much the same story. But when the steamers arrived about a month later they found the straits closed, the north-easterly winds that prevailed in July and August having packed the ice along the eastern shore of Novaya Zemlya. Then the captains seem to have spent a good deal of time in trying to get through by way of Matyushin Shar, for which they all made as being the shortest cut, although, under the circumstances, that particular strait was likely to be the most impracticable of all. The Burrough or Kara, and Pet Straits, appear to have been open longer. At all events the sloop *Kongsberg*, from Hammerfest, passed through the former on the 24th of July. The captain of the *Kongsberg* says he could tell by the ice-blink that Matyushin Shar was then closed by a belt of ice stretching along the east coast of Novaya Zemlya, and that beyond that the Kara Sea was clear. The captains of the steamers do not, however, appear to have been able to read the signs aright. Judging by the voyages of Captain Markham and the *Willem Barentz*, it seems quite possible that they might even have gone north of Novaya Zemlya altogether, and, according to the walrus hunters, they would have found the Kara Sea and Siberian coast quite clear. Fortunately the credit of the Kara Sea was saved by the steamer *Louise*, of St. Petersburgh (Captain Burmeister), which succeeded in reaching the Yenisei, and returned with a cargo of wheat, thus showing that the voyage may be made even in unfavourable seasons*. It is the general opinion of those best acquainted with these seas that all the steamers would at least have reached the mouth of the Ob, late as they were in the field, had they obtained experienced pilots from Tromsö or Hammerfest. Farther progress would probably have been hindered by their great draught.

With regard to this new commercial highway, then, it may be said that the termini are ready for traffic, but that the coast of Norway forms a great gap in the line between them. We must not, however, regard Norway as a mere connecting link between England and Siberia; it is peculiarly interesting to us for its own sake. It is the only part of Europe in which property, from the earliest ages, has been transmitted on the principle of equal partition amongst all the children of a family, and thus exhibits, on a small scale, what America and France may be a thousand years hence. It is the country from which issued, in the tenth century, the men who conquered the fairest portions of Europe; it was the cradle of our noblest energies and blood; and, at the present time, it is a market for nearly all the articles manufactured in England, and it produces commodities which we specially require—wood and iron.

The foreign trade of Norway has, of late years, been exceedingly prosperous. Duties on imported articles have been relaxed, and a great advance has been made towards adopting the principles of free trade. The result has been, not only to encourage intercourse with foreign nations, but also to stimulate the energies of the Norwegians to develop the internal resources of their country. The discovery of coal in several districts will pro-

* The *Louise* reached Novaya Zemlya on the 29th of July, and passed through Jugor, or Pet Strait, on the 8th of September, the east side of Waigat Island being then free from ice, although the Kara, or Burrough, Strait was completely blocked. She left the Yenisei on the 21st September.

bably give a great impetus to mining operations, which have hitherto been restricted to a fixed quantity of fuel. Many of the ores are of extraordinary richness; the iron, in particular, being of the finest quality. The exports from Norway are chiefly deals and timber, salmon, cod and its oil, herrings, lobsters, minerals, furs, and ice. Upwards of 500,000 loads of timber are annually shipped to England, France, Denmark, Holland, and Belgium; and during the lobster and mackerel seasons a number of English vessels are constantly employed in exporting the take, vast numbers of lobsters being sent alive to London. The imports comprise all kinds of colonial produce, wines, and the manufactures of England, France, and Germany, besides salt, coals, iron wares, and numerous articles of luxury, for which the increasing prosperity of the country creates a proportionate demand. In 1877, the value of the imports from the United Kingdom was £2,294,775, and of the exports £2,275,106. In the same year, the total value of the imports amounted to £10,555,555, and of the exports to £6,055,555. Evidently, therefore, our trade with Norway might be extended with advantage to ourselves. The Norwegian mercantile marine shows great activity. In 1876, it consisted of 7,809 vessels, registering 1,436,000 tons, of which steamers represented 45,900 tons. Thus, though the entire population of Norway is only 1,890,000, or but little more than half that of London alone, her mercantile fleet takes rank as the third largest in the world. In 1876, 12,117 vessels, registering 1,829,000 tons, entered inwards; and 12,777 vessels, registering 1,914,000 tons, cleared outwards. Thirty-five per cent of these vessels are foreign, and a very large proportion navigate by our charts. Apart from commercial considerations, we ought to bear in mind the treaty of 1813, by which Great Britain is morally, and in honour, bound to preserve the national independence of Norway, and her singularly liberal and well constructed constitution. In 1855, also, England and France formally pledged themselves to protect Sweden and Norway against any aggression on the part of Russia. I cannot refrain from adding that an Englishman will more quickly find himself at home with the Northmen than with any other foreign people, and nowhere will he be treated with more kindness, courtesy, and honesty than in Scandinavia.

I have now tried to show that, if the new maritime route between England and Siberia is to be utilised to the extent that the advantages to be gained would seem to warrant, we must first study its hydrography, and that independently of any present or prospective trade with the White Sea and Siberia, and apart from scientific questions, which are also of practical importance, the coast of Norway is already so much frequented by our shipping, that our merchants and seamen might reasonably expect to be furnished with reliable information concerning it. It has been urged that our trade with the northern coasts of Europe and Asia is still comparatively small, and if a large sum of money was asked for to carry out a special survey, this consideration would carry due weight. But as the work has already been done and paid for, and as it would have been available to the public at the present time, but for the existence of certain mysterious obstacles called "departmental reasons," the matter assumes quite a different aspect.

As a practical illustration of the condition and prospects of the trade routes under consideration this evening, and as showing the spirit in which attempts to advance the cause of hydrographical science are met in a quarter whence it would be natural to expect co-operation and support, I have been advised to give some account of my Norwegian voyages and their results.

In June, 1874, I sailed for Lapland in the hired yawl yacht *Annie*, of 35 tons register and 9 ft. draught, and being partially disabled by a heavy gale in the North Sea, narrowly escaped shipwreck on the south-west coast of Norway. There were secure harbours within easy reach, but the Admiralty charts were on such a small scale that it was impossible to identify the channels between the numerous outlying islands and rocks; and, though we had the best sailing directions to be procured in England, little was to be gathered from them beyond the obvious fact that the coast was dangerous. Thus, the deficient state of our hydrographic knowledge of this coast—the nearest part of which lies within 180 miles of our own shores—was forced upon my attention. And I determined to do what I could to improve it.

After navigating the principal inner channels, between the 60th and 62nd parallels of latitude, we put to sea, and proceeded, outside the innumerable islands and rocks which skirt the west coast of Norway, to Hammerfest, where I heard from our Vice-Consul that no less than 15 vessels, of various nationalities, had been wrecked on the coast of Finmarken alone, in the gale that so nearly proved fatal to the *Annie*. Here, then, was another incentive to persevere in the work which I had already begun.

On returning to Hammerfest from Lapland, I was strongly dissuaded from attempting to navigate the inner channels without a pilot, especially during the winter. It was the general impression amongst all classes of Norwegians, that the attempt would inevitably lead to disaster. But I believed that it was only considered impossible, because it had never been attempted, and we finally left Hammerfest on the 12th of November, 1874.

I found that the difficulties had not been exaggerated. Sometimes we towed out of anchorages into which we had felt our way in the dark to escape snowstorms, and were glad to get back again for the same reason, after a hard day's work for nothing. Sometimes we were caught in the snow, and then our escapes were narrow indeed, for the strong currents set dead reckoning at naught, and sharp, treacherous rocks lie hidden on all sides. Then the wind was apt to fly half round the compass without any warning, leaving us in imminent danger of being wrecked on a lee shore; and the difficulty of working frozen ropes and sails with frost-bitten hands and feet was increased tenfold by the violent plunging of the vessel in bad weather, for the spray often froze as it fell, and the decks were always slippery with ice. Add to these disadvantages, that in winter the fiords look like lakes of ink surrounded by lofty walls of snow, the winding passages through which are invisible till the ship is close to them; that the landmarks are often obscured for hours together by whirling snow, while many of the anchorages are almost undistinguishable notches in

the bases of lofty mountains, and it will give some idea of what we had to contend with.

The winter of 1874-5 was unusually severe, and the loss of life and property, on the northern coasts of Norway, was very great during the winter fishery. As we were working southward, we only lost the sun for five weeks; so, considering the latitude, we were well off for light; but we had no storm sails, no suitable clothing, and no stove except that in the galley. All the water on board became solid ice soon after leaving Tromsö, and everything in the after part of the ship was covered with thick rime, which occasionally thawed a little, and soaked into the beds, so that they were generally frozen as hard as boards.

It is unnecessary to describe the hardships incidental to such a voyage; suffice it to say that, in consequence of their severity, I was obliged to discharge my English crew, which consisted of three seamen, and a lad who combined the duties of cook and steward, at Bodö, a small town 45 miles north of the Arctic Circle, six weeks after leaving Hammerfest. I then engaged a native crew, none of whom had any knowledge of the coast south of Bodö, and while learning their language, visited all the principal Lofoten fishing stations and other places of importance in the neighbourhood, and paid another visit to Hammerfest, collecting much useful information by the way. After that, we worked steadily southward, past the great glacier-bearing range of Fondalen, the curious natural tunnel through Torghatten, and the terrible breakers off the Frö Islands, where the North Atlantic strikes home on several hundred square miles of dangerous reefs. At last the *Annie* rounded the southernmost extreme of Norway, and returned to England in September, 1875. The voyage was a success, for I had navigated the wonderful inshore route along the coast of Norway without the assistance of a single pilot. It now remained to work out the results.

In the following December, I wrote to the hydrographer, Captain Evans, urging that, for many reasons, it was desirable that reliable sailing directions should be prepared for the Norwegian Coast. I also enclosed a specimen chapter, and offered to complete the work and place it at his disposal. He accepted the offer, and the detailed results of the cruise of the *Annie*, and of my second voyage up and down the coast of Norway in 1876, are now embodied in a volume of sailing directions, entitled "The Norway Pilot." The work was an exceptionally difficult one of its kind, owing to the extreme intricacy of the coast, and the nature of the materials at my disposal; but I can honestly say that I have spared no pains to make it as complete as possible.

The manuscript was finished in June 1879, and I was then informed that the amount of type allowed to the Hydrographic Department was strictly limited, and that until a sufficient quantity was released by the publication of other works, the "Norway Pilot" could only proceed by degrees. This unforeseen stroke of departmental poverty did not, however, break off the relations between the department and myself, and, on the 19th of July, the Chief Naval Assistant wrote to ask if I should not require certain documents for reference when correcting the slip and octavo. Up to that date, therefore, there was clearly no intention of dispensing with my services; but, only six days later, the work was ordered "to stand over" for an indefinite period. On asking for some explanation, I was curtly told that, "for departmental reasons," there was no cause to depart from the arrangements already conveyed to me.

Since then I have repeatedly urged, both officially and privately, personally and by letter, the advisability of completing "The Norway Pilot," and revising the Admiralty list of lights, without further delay. During the months which elapsed, several vessels were wrecked on the west coast of Norway, and in some cases lives were lost. But at last, on the 22nd of January, I was informed that the directions were "passing through the regular course requisite for publication." Now, if the work is considered worth publishing at all, it must be worth publishing in the best possible way, with due regard to economy; and it is no disparagement to the officer to whom the task of editing the book has been assigned, to say that he cannot know as much about it as the author. He is not acquainted either with the Norwegian coast or language, nor has he the means of obtaining various items of local information which I have received since the manuscript was finished, and which are necessary to bring the work up to date. In his hands also, it must be a longer and far more expensive task, so that the country not only gets an inferior article, but actually has to pay more for it.

As an instance of the errors arising from the course that has been adopted, I may state that in the last official list of lights, "corrected" to the 31st of December, 1879, *not one single light* on the west and north coasts of Norway is correctly described in every particular. It is true that some of the mistakes are unimportant from a purely practical point of view, but others are so serious, that, instead of being friendly guides, the lights become treacherous foes, which might lure seamen to destruction instead of warning them of danger. For instance, Kin light is placed on the *inner* side of the island, to lead vessels through the inner channels; but, according to the Admiralty list, it is on the *outer* side of the island, and throws its light seaward, so that seamen seeking shelter on this part of the coast, and running with confidence for a light which is really invisible between the bearings given, might find themselves surrounded by rocks before the mistake was discovered.

Let us try for a moment to realise the awful consequences of a mistake of this sort—the long staggering plunge as the gallant vessel lights on the sharp and cruel rocks, the terrible grinding noise as they tear through her sides, the crash of falling spars, the leaping breakers, which sweep man after man into the boiling surf, and beat upon the devoted ship, until at last only a few pieces of wreckage are left to tell the tale of a despairing struggle for life.

Those who have suffered shipwreck know that it is a scene of indescribable horror; and when we think of the *unavoidable* dangers awaiting all who go down to the sea in ships, we should do well to consider also whether we do as much as we ought to remove the dangers that *can* be avoided. As my representations with regard to the light-list

only elicited bare official acknowledgements, I called on the First Sea Lord, about two months ago, and laid the list before him. Then, and not till then, Kin light was correctly placed on the Admiralty chart, which, however, like all those for the coast between the Naze and the Romsdals islands, is on too small a scale to be practically useful. The Norwegian charts, which are on a scale of about three-quarters of an inch and 1·5 inches to a mile, are very good, and may be bought in all the principal towns of Norway; but it would be necessary for English seamen to master the Norwegian abbreviations and conventional signs before they could use them. It is a matter of regret that these Norwegian charts are not republished on the same scale by the Admiralty; and as it is not very long since the yachtsmen on the west coast, of Scotland succeeded in persuading the Board to publish larger scale charts of part of that coast perhaps a little pressure from without might do good service here also. The Hydrographic Department produces fresh charts continually, and the amount of work done with limited means is highly creditable. Still it appears that the undoubted energies of the staff are not always directed into the most useful channels—they do not always sweep the right chimney. We will take two examples besides that of the "Norway Pilot."

Owing to the urgent representations of Sir Bartle Frere, two large sheets of the east coast of Africa, north of the colony of Natal, were brought out quite recently; but some disappointment was felt by those who wished to use them when it was found that they contained very little new information. The work compiled from remarks sent home by officers who were not trained surveyors, might have been added to the old chart without putting the public to the expense of new plates for the reproduction of old work. A similar course was pursued with one of the charts for the coast of Ceylon, which seamen are wont to approach with a certain amount of respect, on account of its frequent mists and dangerous currents. This chart embraced the approaches to the important harbour of Galle, and was found to be "seriously in error," "omitted several dangerous reefs," and "appeared to be merely an enlargement from the small scale sheet." It was cancelled by the Admiralty, owing to the representations of Captain Taylor, and a copy of the chart issued by the Indian Marine Survey Department was published in its place. Now, if the superfluous time and money expended in these efforts to put new cloth into old garments had been devoted to the republication of the large scale Norwegian charts, the public would have profited by some really new and useful aids to navigation, and the chart of the "Unsurveyed World" might have shown some decrease in the thousands of miles of gaps which have yet to be filled up.

It is a disagreeable, and generally a thankless office, to call public attention to facts of which we cannot but be ashamed; but he would be guilty of a grave dereliction of duty, and would incur a heavy moral responsibility, who, knowing that a pitfall existed, would allow his fellow-creatures to step blindly into it. The question whether England is doing as much as she ought for hydrography is, indeed, one of serious public import, for the condition of our hydrographic service affects the shipping and manufacturing interests of nearly all the maritime nations of the world. Although both our naval expenditure and the tonnage of our mercantile marine have largely increased during the last 25 years—so that accurate surveys are more urgently needed than ever—yet it is a matter of notoriety that the surveying service shows a deplorable decrease of ships and men since the days when it was ruled by Sir Francis Baring and the eminent hydrographer, Sir Francis Beaufort. When, in addition to this, the department actually discourages voluntary work, and re-publishes misleading statements in the face of repeated warnings—as in the case of the Norwegian light list—it is impossible not to endorse the severe but deserved strictures which have from time to time appeared in the public press. As Mr. Clements Markham truly observed, referring to the excellent system inaugurated by Professor Mohn, of Christiania, for utilising the labours of hydrographical volunteers:—"The knowledge that such observations are valued and appreciated will always be a sufficient inducement to commanders to record and report them." On the other hand, the knowledge that such observations are likely to meet with the treatment accorded to the "Norway Pilot" would probably deter even the most public spirited men from taking their work to the Admiralty; and instead of one great central establishment we should have a number of small retail shops, as it were, to the manifest detriment of imperial interests.

The amount of actual work done by our itinerant surveyors, as Commander Hull quaintly terms them, who wander about the world with "limited nautical resources," is as great as can be expected; but its quality can hardly be so good as if each survey were conducted on the liberal scale of the voyages of Fitzroy or Kellett, Belcher or Denham. The late Commodore Goodenough, in common with most thoughtful naval men, was very strongly impressed with the inefficient state of the Surveying Service, and of the Department which has charge of it, owing to the inadequacy of the grants. "It is by no means improbable," he wrote, "that the patchwork which is now being done in various parts of the world may have to be resurveyed within the century." This ought not to be so; and whatever work is done by a country so rich as ours should bear a Roman stamp of permanence which the present expenditure will certainly not permit. He adds: "One cannot readily believe that any English statesman is insensible to the national renown and the lasting utility of such imperial works as those marine surveys, which only a seafaring nation can execute, and which the world expects from England, in fulfilment of the obligations of her maritime supremacy." It is true that by neglecting much-needed surveys the scientific vote has been reduced by a few thousands; but how much money has been lost on improperly surveyed coasts—say, for instance, in the Red Sea, and how much did it cost to repair the *Tenedos*, when she ran aground with the *Active*? Both the public and shipowners have been heavy losers by this penny-wise economy, but we ought surely to consider also the widows and orphans of those "wandering vassals of the faithless deep," who are too often swept suddenly away.

"The faithful wife, for ever doomed to mourn
For him, alas! who never shall return;
To black adversity's approach exposed,
With want and hardships unforeseen enclosed;
His lovely daughter, left without a friend,
Her innocence to succour and defend."

Thus sang the sailor poet Falconer, who was himself fated to perish by a catastrophe similar to that which he so feelingly described. Duty, therefore, as well as interest, forbids us longer to deprive gallant and earnest men of those bloodless battle-fields of daring, endurance, and discovery, where triumphs and trophies are won for the whole human race. Not all the glory belonging to the British navy has been gained by its *Victorys*, *Arethusas*, and fighting *Temeraires;* and though art has chosen to glorify rather the heroes of battle than of peaceful conquests, we ought never to forget that "peace hath her victories no less renowned than war." Our "rough island story" contains soul-stirring records of men who fought against foes more dangerous than an Armada, and with the illustrious names of Drake, and Blake, and Nelson, we cherish those of Davis, Gilbert, and Cook, of Parry, Collinson, and Franklin.

Sufficient proof has recently been afforded of the inability of the Hydrographic Department to keep pace with the wants of the times, to call for some effectual steps being taken to render it a worthy representative of the first naval and commercial power in the world. We shall then hear of no more cases like that of the "Norway Pilot," or of colonies depending so much upon their coasts being made safe of approach as Queensland and Tasmania, declining to continue their connection with the hydrographic department at home. This cannot in any sense be regarded as a party question; it concerns alike our mercantile prosperity and our naval dominions; and the hydrographic service has this further recommendation, that supplying charts as it might do to all the world, it might be made almost, if not altogether, self-supporting. The subject has been taken up by men of the highest distinction and authority—men like Sir Bartle Frere, Sir Geoffrey Hornby, Admiral Ryder, Mr. Clements Markham, Commodore Goodenough, Commander Hull, Mr. Laughton, and many other, who have all insisted strongly upon the advantages, in point of discipline and instruction to officers and crews, of constant practice and experience in surveying. Ships, guns, and gunners may reach perfection, but, as the little *Covadonga* proved on her powerful adversary, they are comparatively useless without skilled pilots and trustworthy charts.

The Royal United Service Institution and the British Association for the Advancement of Science, have published papers containing urgent appeals for the surveying branch of her Majesty's Navy; and at a recent meeting of the Royal Geographical Society, Sir Henry Rawlinson said that the society entirely admitted the responsibility which attached to them to foster hydrography as well as geography, sciences which he happily termed "twin sisters." Sir George Richards, the late hydrographer, writes that there are wide fields for geographical and scientific research, "by which the whole human race would be gainers; and though England, as she is bound to do, does more than any other nation in such work, she is very far in these respects from fulfilling her mission." "Hundreds of her national ships," he continues, "plough the ocean in time of peace, their almost sole occupation the training and preparation for war, and in the very nature of things, so far as scientific research is concerned, they leave no deeper mark than the track which the sea obliterates behind them, while the few—too few—grudgingly appropriated from the largest navy in the world, place their ineffaceable stamp on works of usefulness which last for ever."

I have, therefore, no hesitation in making an earnest appeal to the members of the Society of Arts to exert their influence for the restoration of our Marine Surveying Service to the prominent position it ought to hold among the forces of civilisation; and if it should lead any of those who will consider our discussions to regard the good cause of hydrography in its broader and deeper aspects, then good cannot fail to come of this attempt to clear up the story of Trade Routes along the rugged, but hospitable coast of dear "Old Norway."

DISCUSSION.

The Chairman said this paper had brought a most interesting subject under the consideration of the Society. It had, in a very interesting and agreeable way, shown the dangers of the Norwegian coast, along which the vessels must pass that made use of the trade route which was first pointed out by Baron Nordenskjold to Siberia, and which was expected to open out the resources of that vast country. Lieutenant Temple had described those dangers, and the means needed to enable ships to avoid them; and they must all agree that thanks were due to him for his devotion to the public service, in having, at his own charges and risk, undertaken to survey that coast for the good of commerce and of humanity. His treatment by the Hydrographic Department, as described in his paper, certainly called for some explanation, and until such was given, he (the Chairman) must say, that he never heard of such a case in the whole course of his official experience. Lieut. Temple had very usefully drawn attention, also, to the want of surveys in other parts of the world, and to the decadence of the Hydrographic Department since the lamented death of Sir Francis Beaufort. He had also reminded them that Admiral Richards, the late Hydrographer of the Admiralty, had recently stated that this country was far from fulfilling her duty in the work of surveying, and that but few vessels were grudgingly appropriated to this important work from the largest navy in the world. These were strong words, and they derived additional weight from the source whence they came. The remedy, however, rested with the public. An efficient Government Department welcomed criticism, and could not work healthily without it. Where there was impatience of criticism and secrecy, depend upon it there was inefficiency, and something to conceal. It was important, however, that they should not impute blame to individuals, but to the system. As Commodore Goodenough said once at the Royal United Service Institute, "Above all, do not fancy that the men of a department are against us; the tendency of the departmental system is stronger than the men; and they are in many things as much chilled and bound by the system as we seem to be. That must be so until the day when the general spread of education and intelligence shall set us free from the bonds of the system, while giving us the full use of its machinery." It must be remembered that public discussion acted in two ways. It was at once the spur and the safeguard of a really zealous and efficient department. The result of discussion and public pressure was shown in the Marine Survey Department of India. For twelve years the surveys on the Indian coasts were entirely neglected, to the great

detriment of commerce and the loss of many valuable lives; but the matter was represented in season and out of season for three years, and at last, in consequence of that importunity, it was brought to the notice of the highest authorities. It was to Lord Northbrook—then Viceroy of India, and now First Lord of the Admiralty—that the creation of the Indian Marine Survey Department was due, and it was now doing most valuable work. Only that afternoon, Sir Richard Temple, the brother of the lecturer, was talking to him of the great importance of the Indian marine surveys. This is a great step in advance. As he said on a former occasion, "efficiency and activity have taken the place of sloth and neglect." This result showed that constant and earnest representation was needed to break down the obstruction of subordinates, and to force these questions on the attention of the highest authorities, who were frequently too much occupied to attend to such matters until their urgency obliged them to do so. Reference had been made to the want of charts on that part of the East Coast of Africa, where the *Active* and *Tenedos* were in such danger; and he urged the same thing in his address to the Geographical Society in May of last year. He knew that Sir Bartle Frere had frequently represented the matter to the home authorities, but nothing appeared to have been done. This was but one example out of many, showing the necessity for public discussion, and the Society of Arts and others interested in commerce should stir themselves in the matter. A great responsibility would rest on the public, if they did not keep the matter alive; and he felt that, in bringing it thus prominently forward, Lieutenant Temple had done a great service to commerce and to humanity.

Mr. Richter, Consul-General for Sweden, being called upon, said he was unable to contribute any fact or opinions to the subject under discussion, but he felt convinced that the paper was of great value, and his countrymen were certainly fully alive to the importance of the matter. He was sure the Norwegian Government would be always ready to afford encouragement and aid to the solving of these problems, and begged, on behalf of his countrymen, to acknowledge the great obligations they were under to Lieutenant Temple.

Capt. Foote, R.N., said he hoped the untiring and gallant efforts of Lieutenant Temple, in his little yacht, might be followed by the opening up of trade with many of these glorious harbours to which he had alluded. The Chairman had very ably put before the meeting the points which the public ought to consider, and, bearing in mind England's maritime position, there was no doubt she ought to do more towards mapping out the many blank continents which appeared on the unsurveyed chart. When in Zululand, he had seen the sea breaking over the reefs where the *Active* and *Tenedos* were in danger, and could endorse all that had been said on that point. Had the coast from Delagoa Bay down to Port Elizabeth been properly surveyed, a very large sum of money would have been saved, and the landing might have been effected very much sooner. When a commander was ordered to run several hundred miles along a coast, and report where a landing could be effected, he had an unfair task assigned him; he might have rough weather, and having to take care of his vessel and his men, it was impossible to present a proper report; but had this coast been surveyed, he believed that a landing could have been effected on an average three or four days a week, with suitable boats. He saw 200 tons of stores landed in one day at Port Durnford; but he should not like to say how many hundred bullocks and how many thousand pounds it required to take them where they were wanted. They had heard a great deal recently about the falling off in trade, and the only remedy was to open fresh markets, and that could only be done by surveying. Lieutenant Temple's efforts were well worthy of imitation, and he trusted his example would be followed, for it was an old saying that one volunteer was worth two pressed men.

Commander Cameron, R.N., C.B., said it gave him great pleasure to bear testimony to the value of the work done by his old messmate, Lieutenant Temple, on the coast of Norway. Unsurveyed coasts were the curse of the navigator, but when a proper chart was before him, and he knew how to use his instruments, he was a great deal safer than anyone walking along the streets of London. At present, the coast of Norway was unsurveyed for the British seaman, because he could not evolve out of his inner consciousness the languages of all the countries which he visited, and as he could not therefore read the Norwegian charts, they were practically useless to him. Our trade there was very large, and was likely to become larger and larger, for now Professor Nordenskjold had made Europe and Asia into an island, they would soon find they would have to go to Siberia for wheat and many other things. With regard to the East Coast of Africa, he had been in an open boat nearly all the way from Mozambique to Cape Guardafui; and in the time of the Abyssinian expedition, the work in which he was employed was the charting, buoying, and lighting the passage to Annesley bay, for the transports going out there. The charts were, in many details, most perfect, but unfortunately they were not brought out under the superintendence of the men who had made surveys, and the consequence was that they sometimes overlapped for ten miles, and the ten miles missed were then filled in by fancy. That was a specimen of "stay at home" hydrography. He did not say that anything of that kind was done now, but if charts and sailing directions were not compiled by the men who had worked them out, the same kind of mistakes might creep in. The Norwegian sailing directions compiled by Lieutenant Temple, were being edited for the purpose of so-called economy by someone who had never seen Norway, who did not know the language, or the meaning of the symbols on the Norwegian charts; and that could not be for the benefit of those who traded with that country. The chart of unsurveyed coasts he considered a disgrace to the English nation. We had more ships afloat than almost all the rest of the world put together, and yet the other day it was found necessary to send to Japan for a lieutenant to command a surveying ship. At the present moment, the First Lord of the Admiralty wished to see surveying done, but they had not got men trained for the service. If Lieutenant Temple's sailing directions were published, they would render the coast of Norway almost as well known as that of the British Isles, and he would repeat, in conclusion, that not for that work only, but also for his gallant efforts in saving life there, to which he had made no allusion, he was proud of his old messmate.

Capt. Hull, R.N., said:—There is no doubt Lieutenant Temple has done good service in calling attention to the advantages of our merchant adventurers sending their vessels round the North Cape in search of the produce that may come down the Siberian rivers, and also a new market for English manufactures. The dangers of navigating seas cumbered at times with ice are much reduced by the aid of steam power, but to do this efficiently, another power is wanted, and that is hydrography. Most thoughtful men have observed what the poets call the unity of nature. The same laws govern the pond and the Arctic basin. In winter time, a thaw first affects the edges of the pond; so the genial return of the sun, in spring, first loosens the ice from the shores of the Arctic basin. The sailor, therefore, wants to know the nature of those shores, to enable him to steam between them and the ice in safety. I, therefore, feel sure that the latter part of this paper will be most interesting to the nautical mind, and his pleadings in behalf of hydrography must have been listened to with interest by all true sailors present. As Lieutenant Temple is rather hard on the Light-lists, I should

like to say a word in behalf of my old colleague, under whose care that list is published. I can assure you he does his utmost with the little time at his disposal, but having nearly 3,800 lighthouses and lightships under his care, information upon which comes to him in many languages, the time at his disposal is not sufficient to keep the light lists up to date as efficiently as he could wish, for these light lists are only a part of his many anxious duties. Finding himself in the position of the needy housewife with very little butter to spread over a large quantity of bread, I suppose he does his best to give each of his eight light lists a fair share of his attention. I regret, with Lieutenant Temple, this bringing out of old surveys of some parts of the world, when there is finished work to hand of other parts. I know, by past experience, the difficult and unsatisfactory process of fitting old cloth on to new garments, and, in my opinion, it would be better to correct the old charts up to date, until such time as they could be fairly replaced by charts made by new surveys. In the meanwhile, we ought to lose no time in putting such good charts as the Norwegians appear to have published into a form that they may be used by English sailors generally. I am pleased to see the cause I advocated in 1874, that of the unsurveyed world, so well taken up by Lieutenant Temple. These efforts have produced results which are encouraging, as from one steam sloop in 1873 we have advanced to five steam sloops and three schooners in 1880, and of these five sloops, two are commanded by officers recognised as surveyors. I also advocated in 1874 the increase of the staff at Whitehall. That still remains as it was; and I think what we have heard to-night shows the necessity for augmenting the forces on shore, as well as those afloat, so that the public may have, as soon as possible, the results of the labours of home and foreign surveyors. Very many of the shortcomings of which Lieutenant Temple complains are caused by shorthandedness at Whitehall. Additional work, in the shape of examinations, has been undertaken by the office without any corresponding increase of staff. Foreign Governments take more interest in, and publish more information on, hydrography than formerly, and yet, though the work comes in much faster than of old, the staff of the Superintendent of Charts, or of his deputy, remains the same, and is unequal to the present demands. It may be a bold thing to suggest, but what is really wanted is a hydrographical Oliver Twist, who will fearlessly come to the front, and ask the public Bumble for more help to carry out what is required. Saving money is not governing. Officials have yet to find out that the greatest economist is not the man who saves most, but he who spends most efficiently. In conclusion, I would remind you that if the reader of the paper has been fortunate enough to interest you in these matters, it will be your duty, as representing an influential portion of the British public, to push these ideas, and see that money is forthcoming for the production of what old John Davis defined as "an instrument portable, of easy stowage, and small practice, performing the practices of navigation largely and beneficially." I allude to British charts, for, considering our large population and insular position, it is on those charts, without which no ship can safely sail, that so many, not only of our comforts, but even of the necessaries of life in time of peace, and our safety in time of war, in a great measure depend. Above all, I would ask you to recollect this—you belong to a very rich country, and are sometimes inclined to think that that is everything, but there is one thing money will not give you, and that is trained men. It is only by constant practice in time of peace that men are trained and made ready to give that aid which may be required in time of war.

Lieut. Temple having thanked the gentlemen who had spoken so kindly of his own efforts, said Captain Cameron had spoken of the Admiralty having stopped his work for economical reasons; but as he had pointed out, the course adopted would actually cost more than if he had been engaged, It was quite true, that when he was working for the Admiralty he got a certain amount of pay, but the Hydrographer had himself stated the pay was utterly inadequate to the work, whereas the men now employed got considerably more.

The Chairman then moved a cordial vote of thanks to Lieutenant Temple.

MISCELLANEOUS.

AMERICAN BACON AND PORK.

The following is an extract from a long article on the above subject, in a late number of the *Times*:—

"The hogs of the United States muster thirty five millions, or nine times the number enumerated in the United Kingdom. The abundance of the Indian corn crops of the past few years has stimulated their production at the rate of one million and a half per annum. The average value of the American hogs set forth in the agricultural statistics for 1878 is only 15s. 9d.; but in Colorado and other territories they reach 30s., and in Massachusetts, amount to 45s. 9d. Although of small individual value, the American farmers' capital in hogs represents a total aggregate of £22,000,000!

The subjoined table exhibits the number of hogs packed in three great divisions, of the United States, during each of the three years, ending the 1st of March:—

	1876-77.	1877-78.	1878-79.
The West	7,409,174	9,048,566	10,858,692
The East	2,551,239	2,703,670	3,222,011
The Pacific Slope	305,000	310,000	400,000
	10,265,413	12,062,236	14,480,703

Canada packs about 200,000 hogs. The total annual hog products turned out by packers throughout the States now exceed 25,000,000 cwt., and are increasing yearly at the rate of about 17 per cent. The average weight of the pigs killed in 1878-79 was 217·14 lb.; their average cost, net weight, per cental was 3 dollars 56 cents, or 50 cents less than the average price for the previous year, and only a little over half the price of 1876-77. Tempted by such low prices, packers have everywhere enlarged their business. At many convenient points throughout the West new establishments have been opened. Stocks of bacon and pork, during the earliest parts of last year, accumulated to the extent, it was estimated, of £100,000,000. It seemed as if the supply had outrun the demand. The good harvest in the West increased, however, the home demand for hog products, as for so many other things; the export demand also increased; prices advanced; and surplus stocks have been cleared off, the United Kingdom paying for her annual proportion nearly £10,000,000 sterling.

Large boxes, containg eight to ten sides of bacon, or 500 lb., are almost daily being put up for European markets. Messrs. Armour have large contracts with the United States Government, and, at a push, 150 of these boxes can be put up in a hour. Even in the country of cheap lumber these boxes costs 56 cents each. The bacon bought unpacked goes at nearly a cent less per lb. Of those sides of bacon and shoulders, which are treated in much the same way, Messrs. Armour turns out yearly upwards of 80,000,000 lb. weight. So economical and systematic are the arrangements, and so carefully is the best made of everything that the sides of bacon and shoulders can with profit be disposed of, even at the present enhanced price, at a trifle over 3½d.

per lb. In Liverpool and many other United Kingdom ports large quantities of this bacon, as well as of the barrelled pork, are purchased, washed, nicely smoked, and disposed of at a handsome profit as "Prime Wiltshire," or "First-class Yorkshire."

The hams are of especial interest, for a very large proportion come to England of sizes and cuts to suit various markets. They are sold under many *aliases*, and are recognisable in London shops, where their Chicago origin is not conspicuously set forth. Messrs. Armour last year turned out upwards of 5,000,000 lb. of hams. Their London house alone received during 1879 nearly 300,000 hams, averaging 12 lb. to 13 lb. each, and sold wholesale at about 6d. per lb. In a sweet pickle, made with salt, sugar, and saltpetre, the hams lie in vats for 60 to 73 days, and are changed over three times. Some are subsequently hung for three days in the smoking house, amid empyreumatic, antiseptic vapours of maple sawdust; are scraped, brushed, sewed neatly in calico, stamped, and packed 30 to 40 together in a box with a partition down the middle, to insure ventilation and lessen the risks of bruising. In summer for air they come in crates. The breakfast bacon—the light bellies from pigs six or eight months old, in handy, shapely pieces of 8 lb. to 10 lb.—is treated much in the same manner as the hams, and, when smoked, brushed, and cleaned, is transferred to a packing-room, where each piece is rolled tidily in grey paper and sewn in calico by men who manage the needle with cleverness that a seamstress might emulate. In this department I saw 20 men busy, but in winter 100 are often occupied. Each is expected to put up 200 or 250 parcels for his day's work; the pay varies from 6s. to 8s. a day, but extra money is given for extra work or for extra hours. The breakfast bacon, thus neatly sewn up for the American market, is brushed over with a solution of chrome and rice-flour to prevent access of flies; but the British public naturally object to this coating of the yellow lead salt.

From the usual machines, 20,000 lb. of sausages are usually put up daily, and are readily cleared off by the pork butchers, hotel-keepers, and others, at about 5 cents per lb. Extra work is often required from this department. Several descriptions of sausages are made —liver, blood, and pork; Frankfort, which is partly cooked and smoked, and keeps a week; Bologna, prized in Germany; 'the lion,' which is chiefly sent to France, and keeps a year. A new manufacture has recently been begun. The soft parts of the heads, cleansed and minced, are flavoured with salt, pepper, and spice, carefully cooked, canned in 2 lb. and 4 lb. square tins; are ready for immediate use, or will keep 10 years, and are known as head cheese or brawn.

The American hogs yield about 5,000,000 cwt. of lard. The summer killed average 34 lb., the winter 37 lb. Messrs. Armour, buying hogs above the average in condition, have a yield of fully 40 lb. of lard from every pig killed. In 50 tanks, heated by worms from ten boilers, the fat and other refuse, melted during 10 to 12 hours, are drained off in different grades. The first quality, made from leaf and trimmings, is recognised as 'prime steam lard.' The intestines and refuse yield a lower quantity, known as No. 2 lard, a large proportion of which goes to Europe. Some of the bristles are conserved for brushes and for the cobblers, but the bulk of the hair is sent to this country in bales of 5 cwt., and, mixed with horsehair, is used for stuffing railroad and other carriage cushions. It is now worth £14 per ton. The blood, dried in a revolving steam-heated cylinder, contains about 14 units of ammonia, and is sold for 28 dol. to 30 dol. per ton to the sugar-refining and manure manufacturers. For this latter purpose the firm are now treating for the delivery of 400 tons in the Thames at £12. The bones, after crushing and passing through the lard tanks, and the refuse from every department, are dried, pressed to get rid of grease and water, exposed for 15 minutes in a 25-ft. steam-heated revolving cylinder, and constitute a valuable fertiliser, containing eight units of ammonia and 21 of phosphates, and sold at 16 dol. per 2,000 lb., and is in growing demand among gardeners, nurserymen, and in the cotton plantations."

THE OPIUM TRADE IN PERSIA.

For the last two years the Persians have shown unprecedently great activity in extending and improving the cultivation and growth of opium. The heavy losses which they suffered on more than one occasion from their badly prepared and adulterated stuff, and the tempting profits which they found were obtainable from better produce, have apparently impelled them to the course now taken. While a few years ago a case of Persian opium, weighing 18 Tabreez mans (or 140 lbs.), would not fetch in China more than 280 to 350 dollars, it has recently realised from 500 to 615 dollars. The change cannot be attributed altogether to the improvement in the quality of the Persian drug, as prices are regulated mainly by the state of the Indian produce, and by the demand in the China markets. The Bengal and Malwa crops failed in the last two years owing to drought and other circumstances, and the limited outturn, coupled with heavy speculation, tended towards the increase of prices. The prospect of the crops in India, however, of the current year, is said to be favourable, but the trade in opium is not expected to be very remunerative. In Persia, from the time the attention of the native merchants was attracted to the trade, about 25 years ago, there has been, with two or three exceptions, a gradual annual increase in the production of the drug, but this increase has never before been so very considerable as to become prominently noticeable; now, the cultivation of the poppy and exportation of opium through Bushire and Bunder Abbass steadily increases. The returns for Bushire show an increase in that article over the previous year of 1,754,000 rupees, the quality in 1878 being very superior to that of previous years. Great care is now taken to prevent adulteration, the chests containing the opium being occasionally examined by experts, and considerable attention is naturally bestowed on a branch of commerce which is becoming a mainstay of the Customs receipts, and which has already conduced to better the condition of the classes engaged in the various stages of the operations. When the Persian opium trade was in its infancy, the drug was sent in sailing vessels to Java, and thence re-shipped in steamers for Singapore and Hong Kong. The Dutch Government, however, having imposed certain restrictions at Java, Aden was subsequently selected as a port of transhipment, and, later, Suez, at which port no duty is levied for transhipment. The Persian Steam Navigation Company now send occasional steamers from the Gulf to Galle, for conveyance of opium, when a sufficient quantity is collected to remunerate by freight. In 1878, poppy seed having risen in price in Europe, a considerable quantity was shipped to England for the first time. Consul Ross states that the trade report of Bushire for the year 1874-5 shows, in a tabular statement, the fluctuations of the annual estimated produce of opium in Persia from the year 1868-69 to 1874-5, from which it appears that the largest producer for any one year did not exceed 2,600 cases (a quantity inappreciably small in regard to the demands in China), and in 1874-75 it had fallen to some 2,000 cases. In the following year, there was a further decline, the exports amounting to about 1,890 cases. Since 1876-77, however, a reaction seems to have taken place, as, in that year, 2,570 cases were exported from Bushire and Bunder Abbass alone. In the early part of 1877-78, the probable yield of the crops was estimated at 3,500, but the actual number exported from Bushire and Bunder Abbass amounted to 4,730 cases. Last year, 1878-79, the amount produced was stated to have been 6,700

cases, while 5,900 were exported from these ports. The probable yield of the crops of the current year, 1879-80, is at present estimated to be as follows:—In Khonoar, about 950 cases; in Kerman, 300; Yezd, 1,000; Ispahan, 2,400; Nereez, 400; Shiraz, 1,300; Kazran, 100; and in Shuster, 100 cases; making a total of 6,550.

In addition to the above 6,550 cases, about 3,000 "Shah mans," or, say, 550 cases, are expected to come to Yezd from Herat, making the whole stock about 7,100 cases. The Shuster opium is sent through Mohammerah direct, and sometimes *viâ* Bushire to Mussah for transmission to Zanzibar; but a part of it is supposed to be smuggled into the Indian frontier provinces *viâ* Mekran and Beloochistan. Thus 7,000 cases are expected to be available during the current year for export through Bushire and Bunder Abbass to China and England. Small quantities of opium are said to be grown in Teheran, Tabreez, and Kermanshah, but these mostly find their way to Europe *viâ* Turkey, Smyrna being, it is alleged, the port where it is mainly taken to, and where it is mixed with the local drug and forwarded to the Continental markets.

Opium is made up in cakes varying in weight from ¾ lb. to 1½ lbs., and in number from 96 to 192 or more, and these are packed in fig or vine leaves, and sometimes in poppy seeds or stalks, into cases containing each from 10½ to 11 "Shah mans"—a "Shah man" being equivalent to about 13½ lbs. English. The object in so packing in cases, as regards the weight, is that the contents, after the deficiency caused by drying up in course of transit, which is calculated at from 5 to 10 per cent., may realise at destination (China) one "picul," which is about 135 lbs. Another reason is that the weight is arranged for convenience of carriage by pack animals, generally mules, employed in these regions.

About five-sixths of the produce of opium in Persia is intended for China. The drug suitable for that market being required to be fine, and prepared with oil, and not rich in morphia, permits of its being swelled up with foreign substance, and thus, as far as practicable, adulterated to the extent of precluding discovery by the mode of testing or "touching" used in China. It is said that pure and superior opium, though not so finely manipulated, has been rejected in China, while the fine opium, containing admixtures, has found favour and fair market. The preparations made for the China marts being, say, of a quality of 80 "touch" (containing 80 per cent. pure juice, and 20 per cent. foreign substance) yield from 9 to 10 per cent. morphia. The preparations for England, which have recently been specially made pure, and which have come into favour in Europe and America, have, it is said, yielded morphia averaging about 12 per cent.

The average price for fair quality of opium, suited for the China market, has been for the last two years about 950 rupees per chest, and for the special preparations for England about 100 rupees more. To these are added the charges of transit, and other contingent expenses, from the place of product to the port of shipment amounting to about 30 rupees, and further a Custom and octroi or other duty of about 20 rupees, payable by a Persian, or 5 per cent. *ad valorem* by a British or other foreign merchant.

TALKING MACHINE.

An improved form of Prof. Faber's well-known talking machine is now being exhibited in London. The machine is the result of attempts to imitate the human voice, carried on during a period of 65 years by two members of the same family. Joseph Faber began his experiments in 1815, and had so far elaborated his machine in 1841 that he was able to exhibit it to the King of Bavaria in that year. The original inventor bequeathed his machine to his nephew, the present proprietor, Prof. Joseph Faber, who has greatly added to its capabilities of articulation. The sounds issue from the mouth of a head attached to the machine, and are obtained by the blowing of a bellows upon the various parts of the mechanism, the air being driven, with varying force, by means of a pedal lever. At the back of the head is a small chamber, which represents the human larynx. This is the most complex portion of the machine, and contains certain stops, or diaphragms, by which particular sounds are obtained, such as the lisping "s," or the "sh." A revolving arrangement, like a windmill, gives the rattle of the letter "r." A smaller chamber, with a pipe curved upwards, allows the air to escape, and supplies the place of a nose. There are only 14 keys, representing a selection of letters, and the remainder of the alphabet is obtained by double action. For instance, the valve of the "nose" is opened at the same time one of the keys is depressed, and a sound obtained differing from that of the key alone. By these means, words and sentences in several languages are articulated with something approaching distinctness; but, although the pitch can be raised or lowered at the will of the operator, it remains the same during the utterance of a word or sentence. The machine was exhibited before the Physical Society a few months ago.

CORRESPONDENCE.

ICELAND AND ITS RESOURCES.

I observe in Mr. C. G. Warnford Lock's interesting and valuable paper, on "Iceland and its Resources," read before the Society on 27th ult., the following statement:—"In a very recent consular report, it is stated that an Edinburgh firm now has the whole of the brimstone trade of the island in its hands. This is emphatically incorrect." (*Journal*, vol. 28, p. 508.) Mr. Lock's own information is emphatically incorrect, as it *is* the fact that I am the proprietor and lessee of the whole sulphur-bearing deposits in Iceland of any importance, including those of Krisuvik, Hengill, Kraflanámar, Hlíðarnámar, and Fremri-námar, which I have been working during the past year, and am continuing to work with satisfactory results.

I am sure that no one will be more anxious than Mr. Lock that his unwittingly erroneous remark should be corrected, and shall be obliged if you will have the goodness to insert this letter in the next issue of the proceedings of your Society.

THOMAS G. PATERSON.

53, George-street, Edinburgh,
May 12th, 1880.

NOTES ON BOOKS.

Catalogue of Books and Papers relating to Electricity, Magnetism, the Electric Telegraph, &c., including the Ronalds Library. Compiled by Sir Francis Ronalds, F.R.S., and published by the Society of Telegraphic Engineers, with a Biographical Memoir. Edited by Alfred J. Frost. London: E. and F. N. Spon. 1880.

This volume (which contains over 13,000 entries) forms both a catalogue of the Ronalds Library and a bibliography of the special subject to which Sir Francis Ronalds devoted his life. The first paper Ronalds wrote was a short communication to the *Philosophical*

Magazine, in 1814, and two years afterwards he demonstrated, by actual experiment, the possibility of an electric telegraph. It was in 1816 that he received the often-quoted letter from Mr. (afterwards Sir John) Barrow, in reply to his application to the Admiralty:—

"Mr. Barrow presents his compliments to Mr. Ronalds, and acquaints him, with reference to his note of the 3rd instant, that telegraphs of any kind are now wholly unnecessary; and that no other than the one now in use will be adopted.

"Admiralty Office, 5th August, 1816."

Although the electric telegraph was erected and worked at Ronalds's house, in the Upper-mall, Hammersmith, in 1816, the published description did not appear until the year 1823. The compilation of this catalogue was the work of many years, and in 1852, on his retirement from the direction of Kew Observatory, Ronalds lived for many years abroad, principally in Italy, where he enjoyed exceptional opportunities for obtaining foreign works on electricity. On his death, in 1873, the library came into the possession of his brother-in-law, Mr. Samuel Carter, it having been bequeathed with an expressed desire "that it should not be dispersed, but should be preserved in an entire, and so as to be of as much use as possible to such persons as from time to time should be engaged in the pursuit of electrical science and other cognate sciences. Mr. Carter considered that he would be best carrying out the wishes of Sir Francis Ronalds by handing the library over to the Society of Telegraph Engineers, which he did upon trust." When the society undertook the publication of the catalogue they desired to complete it up to date, but the donor made a stipulation that it should contain no additional entries. It is, therefore, proposed to issue shortly a supplement containing the materials which have been collected by the Society. As might be expected from the extent of the work, a large proportion of the entries consist of titles of papers in journals and transactions.

GENERAL NOTES.

National Training School for Cookery.—A course of ten lectures on "Food, its Properties, Uses, and Cookery" is now being given by Miss Barnett at the School for Cookery, Exhibition-road, South Kensington, on Thursdays, at five p.m. The first lecture was given on the 20th inst. The fee for the ten lectures is 9*s.* 6d., or 1*s.* a lecture.

School of Art Wood-carving.—One free studentship in the day classes and four in the morning classes of the School of Art Wood-carving at the Royal Albert-hall, Kensington, are now vacant. These studentships are maintained out of funds provided by the City and Guilds of London Institute for the Advancement of Technical Education. Forms of application and prospectuses of the school may be obtained by letter, addressed to the Secretary, School of Art Wood-carving, Royal Albert-hall, Kensington, S.W.

Wool Exports from New Zealand.—The total quantity of wool exported in 1878 amounted to 59,270,256 lbs., of the declared value of £3,292,807, against 64,481,324 lbs., of the declared value of £3,658,938, exported in 1877, a decrease of 5,211,068 lb. in quantity, and of £366,131 in declared value. A decrease in the export in any calendar year is not necessarily caused by a decreased production, as an early or late shearing may materially diminish or increase the exports for the ensuing calendar year. The increase of the wool production will be more accurately ascertained by dealing with exports for the year ending on the 30th September, *i.e.*, immediately preceding the spring shearing. The reports for the last six years, ending respectively on the 30th September, were as follows:—1873, 42,233,470 lbs.; 1874, 47,424,882 lbs.; 1875, 49,942,148 lbs.; 1876, 55,975,177 lbs.; 1877, 56,520,278 lbs.; 1878, 62,166,251 lbs. The wool produce for the last year, therefore, actually increased by 5 645,973 lbs. in weight, and by £355,484 in declared value, instead of being reduced in quantity as might otherwise appear from the comparative exports for the calendar year 1877 and 1878.

Substitute for Hops.—The *Gardeners' Chronicle* notices the use in Germany, of the Buckbean (*Menyanthes trifoliata*) as a substitute for hops in brewing. The leaves need be gathered in spring, and dried in the shade. The use of the plant for brewing is said to have been introduced into Sweden by an English sailor in the year 1789.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 24th...British Architects, 9, Conduit-street, W., 8 p.m. Adjourned discussion on Mr. James Allanson Picton's paper, "Iron as a Material for Architectural Construction," and Mr. Alex. B. W. Kennedy's paper, "Mild Steel and its Applications to Building Purposes."

Social Science Association and Society for Promoting the Amendment of the Law, 1, Adam-street, Adelphi, W.C., 8 p.m. 1. Paper by Miss Francis M. Buss. 2. Discussion on the paper by Mrs. Garrett-Anderson, "Educational Pressure."

Tuesday, May 25th...Royal Institution, Albemarle-street, W., 3 p.m. Mr. Fiske, "American Political Ideas." (Lecture II.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on the following papers:—1. "The Manufacture and Testing of Portland Cement." 2. "Portland Cement Concrete, and some of its Applications." 3. "Portland Cement: its Nature, Tests, and Uses."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. John Milne, "The Stone Age in Japan." 2. Mr. C. Pfoundes, "The Japanese People."

Royal Horticultural, South Kensington, S.W., 1 p.m.

Wednesday, May 26th...Telegraph Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Edward Graves, "A Decade in the History of English Telegraphy."

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Prof. C. Abel (of Berlin), "The Diversity of National Thought as Reflected by Language."

Thursday, May 27th...Royal, Burlington-house, W., 4½ p.m. 1. Profs. Ayrton and Perry, "A Preliminary Account of the Reduction of Observations on Strained Material, Leyden Jars, and Voltameters." 2. Mr. W. H. Preece, "Some Thermal Effects of Electrical Currents." 3. Mr. W. K. Parker, "The Structure and Development of the Skull in the Batrachia." Part III. 4. Dr. Russell and Mr. S. West, "The Relation of the Urea to the total Nitrogen of the Urine in Disease." 5. Mr. J. B. Hannay, "The Artificial Formation of the Diamond." 6. Mr. J. N. Lockyer, "Further Note on the Spectrum of Carbon."

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, 3 p.m. Mr. T. W. R. Davids, "Buddhist Sacred Books." (Lecture II.)

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

National Health Society, 23, Hertford-street, W., 4 p.m. Mr. Ernest Hart, "The Doctor in the Kitchen."

Friday, May 28th...Royal United Service Institution, Whitehall-yard, 3 p.m. Major-General Sir Michael A. Biddulph, "The March of the Quetta Column from the Indus to the Helmund River and back."

Royal Institution, Albemarle-street, W., 9 p.m. Mr. F. Hueffer, "Musical Criticisms."

Quekett Microscopical Club, University College, W.C., 8 p.m. Mr. A. D. Michael, "Two Species of *Acarina* not hitherto recorded as British."

Institute of Bankers (at the Theatre of the London Institution, Finsbury-circus, E.C.), 6 p.m. Mr. John Smith, 'Suggestions for the Improvement of Bankruptcy Law in England, chiefly founded on a comparison of the Scotch and English Acts."

Clinical, 53, Berners-street, W., 8½ p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "The Physiology or Functions of Plants." (Lecture IV.) "On the Organs of Reproduction."

Saturday, May 29th...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "The Dramatists before Shakespeare." (Lecture II.)

Sanitary Institute (at the House of the Society of Arts), 4 p.m. Annual Meeting.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MAY 28, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

UNION OF INSTITUTIONS.

The following Institution has been received in the Union since the last announcement :—

Working Men's College, Middleton, Lancashire.

CONVERSAZIONE.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday, the 16th of June. The cards of invitation will be issued shortly.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The annual Conference will be held on Thursday and Friday, the 10th and 11th June, 1880, at 11 a.m. each day, the Right Hon. JAMES STANSFELD, M.P., in the chair, assisted by the members of the Executive Committee.

It has been thought well that, at the Conference for the present year, certain subjects suggested by previous Conferences, should be discussed. These will be arranged under the following headings :— I. Administrative Organisation. II. Amendment of the Law. III. Sanitary Inspection and Classification of Dwellings. IV. Further Suggestions by Sanitary Authorities. It must be understood that neither the Council nor the Executive Committee of the Conference express any collective opinion on the various points which they recommend as suited for discussion.

The full particulars of the Conference have been already given in two previous numbers of the *Journal*, and a programme can be obtained on application to the Secretary of the Society.

An Exhibition of Sanitary and other Appliances in connection with Water Supply, Sewage, and Health, will be held during the Conference. All articles for exhibition must be delivered, carriage free, at the Society's House, John-street, Adelphi, not later than Saturday, the 5th June, 1880. Manufacturers and others desiring to exhibit should communicate at once with the Secretary of the Society.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

An Examination for the above purpose will be held at the House of the Society of Arts during the week commencing 7th of June. There is no limit in respect to age, occupation, or position of the candidates. The examination will consist of three divisions, viz., for First and Second-class Certificates, and for Honours. Further particulars may be obtained on application to the Secretary of the Society.

APPLIED CHEMISTRY AND PHYSICS SECTION.

May 20th, 1880; J. NORMAN LOCKYER, Esq., F.R.S., in the chair.

The paper read was—

SOME RECENT ADVANCES IN PHOTOGRAPHY.

By Captain Abney, R.E., F.R.S.

Some few years ago, Mr. J. Spiller, F.C.S., had the honour of reading a paper on this same subject before this Section of the Society of Arts, and, when he did so, he had one advantage which I have not, in that the advances made up to that time, and which it would be unnecessary for me to recapitulate, admitted of lecture-experiment much better than do the more modern advances; and it must be remembered that the ability to experiment depends largely on the nature of the processes described. My work will commence where Mr. Spiller's left off. At that time, viz., 1875, negative processes were very far behind what they are at the present day, and what may be called "a new departure" has been made during the last two years. This new departure is the gelatino-bromide process. Now, as this paper to-night will be recorded in the Society's *Journal*, I must be excused, though it may be familiar to many, if I give an outline of this process, and if I recapitulate its advantages and disadvantages over the old wet collodion process. Roughly speaking, a gelatine emulsion consists of a finely suspended sensitive salt of silver in gelatine, and the method of producing such suspension may be effected in one or two ways. The only way that I shall attempt to describe is that most ordinarily practised, which is that a certain amount of soluble bromide (if silver bromide is required in the emulsion) is dissolved in a weak solution of gelatine; silver nitrate in solution added gradually, and

with stirring, till finely suspended silver bromide is produced. I do not wish to enter into any controversy as to whether to Dr. Maddox or Mr. Burgess should have the credit of first bringing into notice this process, and I had rather not decide; but I may say that Mr. Kennett was the first who gave what may be called a really workable process to the photographic public, publishing such details as enabled others besides himself to prepare an emulsion. After making advances, one is apt to forget by whom the foundation on which they have been made was laid, and I am sure that, in the gelatino-bromide process, this is very much the case, myself being included amongst the number of forgetful ones. There are certain physical qualities in silver bromide which conduce to sensitiveness, the principal one being, perhaps, a certain coarseness of grain, such coarseness being only effective when the grains are gradually built up, as it were, of finer grains. To effect this, Mr. Kennett first proposed to keep the gelatine, with the suspended salts, in a liquid condition, at about 90° Fahr., for from three to seven days. The longer the cooking, the greater the sensitiveness that was obtained, though, after a certain point, the vigour of the developed image was certainly wanting. A later plan—instead of emulsifying for such a long period, and running the risk of the gelatine decomposing—is to boil the emulsion, to which only a small quantity of gelatine has been originally added, for half an hour, and afterwards to add gelatine till it attains a proper setting consistency. The physical characteristics of the sensitive salts are similar in each case. The sensitiveness to light of a plate coated with either of these emulsions, and allowed to dry, is something marvellous; and here we come to the first advance made in the process—an advance of no small moment, considering that we now can photograph in one second of time what previously it took at least 30 seconds to secure. I need not detain you with a description of the washing out of the soluble salts from such an emulsion; it is sufficient to say that their elimination should be very complete, the sensitiveness being very largely dependent on its thoroughness.

We now come to the advantages and disadvantages of this process over the old wet process. The sensitiveness of these plates is, perhaps, their greatest charm; and, when it is said, and truly, that a plate can be prepared which needs but 1-60th part of a second's exposure to secure a soft and harmonious negative when a view is fairly lighted, there is a feeling that a new era has dawned in photographic art. Instantaneous views are now possible under circumstances which were impossible; for instance, we have here a picture of foliage and water by Mr. Gale, in which he has absolutely caught a swallow poising in the air over the pond, the shadow and reflection of it being perfect. Such a combination of adjuncts would formerly have been impossible, but here we have it almost absolutely perfect. Mr. England has kindly sent me some beautiful transparencies of instantaneous negatives, which also show its capabilities. Another advantage in the process which I have thus briefly sketched is the excessive cleanness of the plates; no mottled skies or stains disfigure a picture; and not only is there cleanness in the plate, but there is cleanness in the development, though this attribute is shared by other processes. One more advantage, too, has the gelatino-bromide, and that is the wonderful power it has of keeping the impressed but invisible image from fading away after the plate is exposed, and before it is developed. In my own experience, a plate which has been exposed six weeks ago can be developed to-day as perfectly as it could be immediately after the image was impressed. Others, too, I believe, have tested this quality in the plates, and their experience coincides with mine. If a plate will keep six weeks, it will keep six months, and, I might say, six years, since the most crucial time in other processes for the fading to commence is about a fortnight after exposure. Before exposure, the plates will keep, I believe, indefinitely so long as they are not kept in a very damp atmosphere, and if they have no glycerine mixed with the gelatine. Here, then, we have positive advantages in a dry plate process, which before could only be considered as problematical. We now come to the disadvantages of the process; and the first is the most serious to my mind, and that is the fact that the development and the giving of density to the image is almost completely out of the hands of the photographer — he must let come what will. I do not mean to say that a general intensity cannot be given, for it can; but what I mean to affirm is that local intensity is very difficult to give. I will show you what I mean. Here I have two negatives; one thin, and the other intensified by means of the deposition of silver from a pyrogallate of silver solution. It will be noticed that in the latter local intensity has been given, whilst in the other it is completely absent. Now, these negatives were taken by the collodion process, and intensification by means of silver was safely conducted with very ordinary care. With a gelatine plate, unless extreme care be used, such a mode of intensification is inadmissible. For an artist, then, who has his own ideas regarding light and shade, and who uses the intensifier as the painter does his brush, there is a certain drawback in the use of gelatino-bromide plates; but, to the artist who works in a studio, in which he can twist his light as he will, there should be none.

The modes of general (not local) intensification at present in vogue with those plates is dependent on the action of a mercury salt. This is a treacherous substance to deal with—when collodion is employed, at all events. I have a bad example here to show you, where the negative is turned of a lemon yellow colour. Whether it will act so with gelatine is a question which time alone can settle.

The next disadvantage, till quite lately, was the fact that the light which had to be employed in the developing room was of a red hue, coming through various thicknesses of ruby glass. This, as all workers are aware, is a very painful light for the eyes, and, where the quantity is reduced, it becomes a very serious matter to the photographer, whose sight would probably be injured by much work in it. This is overcome by a suggestion I made—and carried out—that a small proportion (say one-eighth) of silver iodide should be used with silver bromide, which, up till now, has been the universal silver salt employed. More than a year ago, I carried out my first experiments with the photo-spectroscope in this direction, and

found that, as you increased the quantity of silver iodide in the emulsion, so you diminished the sensitiveness of the plate to the red, orange, yellow, and green rays, till, by using one-fifth iodide, the spectrum would only impress itself as if on a wet plate. This slide will show what I mean. The lowest photograph of the spectrum is taken on a plate in which there is no iodide, the second contains one-twelfth, and the third one-eighth part of iodide to one of bromide of silver. This means, then, that with one-eighth iodide of silver to one of bromide, orange light can be used with impunity when coating and developing plates with such an emulsion. During my recent experiments, I found Mr. England working with iodide, and he, as well as myself, remarked on the wonderful clearness of the shadows that the addition of iodide gave; which is a second benefit it conferred, since it caused not the least loss of sensitiveness to the upper part of the spectrum, which, many at first were (and may still be, for anything I know to the contrary) disinclined to believe. I think, then, that, in the gelatine-bromide process, we may say the addition of the iodide is a benefit. Were I to enlarge on this fascinating theme, I should, I am afraid, take up the whole hour which is allotted to me; but, as I have several more subjects to introduce to your notice, I must hasten on.

With the gelatine process, I have commenced, perhaps, where I ought to have ended, and I must hark back. In Mr. Spiller's paper is mentioned briefly the collodio-bromide process, in which silver bromide is held suspended in collodion, and used on a plate in a similar manner to the gelatine. There is a great advantage in this process, in that the emulsion occurs readily, the solvents being very volatile; but it is not so rapid, at present, as the gelatine process, for a reason which I shall endeavour to explain.

Before doing so, I must call the attention of the meeting to an adaptation of collodion emulsion and a flexible support. This does away with the necessity of glass, and its consequent weight, and, it also enables rolls of sensitive material to be stored in the camera itself, and, by merely turning a screw, to place inside fresh portions of the band ready for exposure. This discovery, in its present practical form, is due to Mr. Warnerke, whose name I shall have to mention several times before I close my paper. I will very briefly explain how this tissue is manufactured. Plain paper is first given a layer of india-rubber solution, then one of plain collodion, next, another of india-rubber, and so on till five or six such coatings are given, the final one being of india-rubber. Collodion emulsion is then poured over it and allowed to dry, and the tissue is then ready for exposure. After development, the back of the paper is moistened with a little turpentine, and the film bearing the image strips off. I have here several examples of these flimsy negatives, and would remark that to print them it is merely necessary to place them on glass. When Mr. Warnerke shall have introduced a flexible support for gelatine emulsion, we shall have nearly the *ne plus ultra* of photography as far as negatives are concerned.

I would now point out that it is perfectly feasible to bring the silver salt into the same physical condition as in the gelatine bromide in collodion emulsion process, but then the dried media which holds it on the plate are physically very different. Gelatine is a colloidal body, separating one particle of bromide from another by a wall of matter pierced with difficultly by the water of the developing solution. The collodion, on the other hand, is a network in which is imprisoned the salts, which are, in consequence, readily accessible to the active reducing power of the developer. The question arises—What effect has this? The answer is simple. The alkaline developer will reduce silver bromide, which has not been acted upon by light, in an almost equal degree as it will that which has been acted upon by light, if it have free access to it, and if a powerful retarding agent, such as a soluble bromide, be not added to it. This retarding agent checks the development, and has a tendency to destroy the previous action of light. Owing to the nature of the gelatine, it acts as a restrainer and not a retarder; and here a smaller quantity of bromide need be used, with the result that, although in both cases the physical nature of the silver salt may be such as to give the extremest sensitiveness, yet, in the one case, the effect produced by light is greatly destroyed, and in the other very little; hence, probably, the great cause of difference in rapidity of the two processes. With collodion, however, we can get a physical condition of the bromide which is different from any which can be obtained in gelatine, as far as my experience goes; that is, we can get a particular state in which it will answer to the vibration of rays of the lowest refrangibility. During five years, this physical condition of silver bromide has occupied my attention, and, in my Bakerian lecture to the Royal Society for this year, I have fully described the means of producing this peculiar state of the bromide. It would be too long to consider this point here; it is sufficient to say that, by preparing a very dilute collodion emulsion, in the first instance, with a large excess of acid, this physical state can be arrived at. I will show on the screen the kind of bromide usually obtained, and now I show the other variety, which is of a green-blue colour. The one, by its colour, we should guess, can only be sensitive to the blue and violet rays, and a little in the green, while the other ought to be sensitive to red, since a great deal of the red of the light is absorbed, and, where there is absorption, work of some kind must be done.

Here we have photographs of the solar spectrum, which have been taken on this salt. The limits of the visible spectrum lie between about wave-length 39,000 and 76,000 tenth millimeters. The part I have photographed extends below the visible spectrum, and lies between 76,000 and 200,000 tenth millimeters, or we have photographed, with wave-lengths of radiation which lie more than three times below the red than the distance of the visible spectrum. The map I hand round is taken from measurement from photographs of the solar spectrum, made by means of a defraction grating, and shows in detail their continuous spectrum from 76,000 and 10,500 tenth millimeters. Beyond that, at present, I have not mapped with this grating, as the light is very feeble at the best of times. With the prismatic spectrum, the limit reached is that already stated, viz., about 200,000 tenth millimeters. The application of this process is already bearing fruit. Major Festing and I are ex-

amining different colourless bodies, such as the alcohols and others, and, I doubt not, from what we have already got, that the chemist's view of compound radicals will be confirmed by results of spectroscopic analysis in the infra-red portions of the spectrum.

I have now to call your attention to the result of a research made on the undeveloped photographic image; and I trust that, in doing so, it may not be thought that I am speaking too much of my own work. My excuse is that I believe, in time, it will bear fruit in the hands of someone, and may greatly enlarge the scope of photography. The result obtained was that the photographic image, which is primarily produced on the plate by means of the splitting up of the silver salt into a lighter molecule, and some halogen, such as bromine or iodine, is rendered non-developable by means of oxidising agents such as bichromate, permanganate of potash, hydroxyl, ozone, nitric acid, and so on. It matters not whether the image be produced on a collodion or gelatine film, or on paper, the result is precisely the same. The immersion of an exposed plate in an oxidising solution will totally destroy the developing capacity of the image.

This oxidation of the image, I also proved, goes on in ordinary atmospheric conditions, more especially under the influence of light. Thus we have a simple explanation of what is known as solarisation. You must picture to yourselves light acting on the salt, first to split its molecules up, into its components already indicated, and light still further acting, and causing the smaller silver molecule thus formed to become oxidised, and refusing to develop. The oxidisation is best affected by the red rays and ultra-red. An examination of a solarised plate in most cases shows a decided "blueing" of the salt, which means that the red rays are absorbed, and can, therefore, do work upon them. Some careful researches showed that to this oxidation might be properly ascribed the reversing action of the red rays on the Daguerrotype plate, so long ago described by Draper and others, when, after a short preliminary exposure, it was placed in the spectrum. This was found to be the case, and the same result was produced with silver bromide, in collodion—in the form sensitive to red light. This oxidation of the silver salt, which had been acted upon by light, caused me to try if the coloured spectrum produced by Becquerel and Victor de Nièpce would be due to this cause. The results I have already communicated in a note to the Royal Society. The colours obtained under these circumstances are true pigments, and not the results of interference, as was formerly held; in fact, by transmitted light, when taken on collodion, the colours are as marked as when viewed by reflected light.

Time flies so rapidly that it is necessary I should hurry on to printing processes, one of which is new in almost every particular, and which is absolutely permanent. Mr. W. Willis, jun., found that he could obtain an image in platinum black, by means of development, if he sensitised his paper with ferric oxalate with which was mixed a solution of chloro-platinite of potassium. The action of light on this paper is to reduce the ferric salt to the ferrous state, and, when the ferrous salt is in solution, the platinous salt is reduced by it. By floating the exposed paper on a solution of neutral potassium oxalate, which is a solvent of the ferrous oxalate, the platinum salt in contact with it is immediately reduced to the metallic state, and an image is thus built up. Through the kindness, and with the aid of, Mr. Berkeley, of the Platinotype Company, I am able to demonstrate this process to you with effect. The sheets of paper have been previously exposed to light beneath a negative, and, by floating them on a hot solution of the neutral potassium oxalate, the image at once flashes out. To fix the prints, they are immersed in dilute hydrochloric, which dissolves away any ferric oxalate there may be, and also gets rid of any oxalate of lime which may be formed.

The sensitiveness of this process is about four times that of the ordinary silver printing process, and this has enabled direct enlargements to be made by means of the electric light. The beautiful prints which you see on the wall are specimens taken in America, the time of exposure varying. I believe, between ten minutes and half an hour, These prints are purposely rather feeble, as they are meant to be a basis for working upon with the brush. To my mind, the platinum process is the greatest advance in printing that has been made for many years, and one great feature in it is its permanence.

I have another printing process which I should also like to demonstrate to you, though it is in a somewhat imperfect state, and is waiting for someone to improve it. It is based on the reduction of silver bromide which has been exposed to light by ferrous oxalate, a discovery which is also due to Mr. Willis, and almost simultaneously by Mr. Carey Lea, of Philadelphia. This developer, I may remark, is often employed for gelatine plates, and for collodion emulsion plates. I know nothing better. It is an extremely vigorous developing agent, and gives wonderful black tones to a negative. Another advantage it has is that it does not stain paper permanently which may be immersed in it. A little diluted hydrochloric acid speedily clears the paper of all colour, and leaves it in its pristine whiteness.

The process was one which gave me some trouble, as I wished to adapt it to the self-recording instruments used at Kew. After many experiments, with the details of which I will not weary you, it was found that, by forming a bromoiodide of silver in the pores of the paper, a print would be easily obtained. The paper is first immersed in a solution of soluble bromides and iodides, and, when dried, it is floated on a bath of silver nitrate, and then thoroughly washed. When dried, it is exposed behind a negative, twenty or thirty seconds to gaslight being sufficient. It is next immersed in a weak solution of ferrous oxalate, and gradually the image is built up. The slower the development, the more the image is on the surface. A little sizing on the face of the paper would improve matters. When well washed, it is treated with a little dilute hydrochloric acid, and can then be toned with platinum, gold, iridium, and so on, any colour, up to a sepia colour, being obtainable. The print is treated with dilute ammonia, and then fixed in hyposulphite of soda, and finally washed. As to the permanence of these prints, I believe it to be great, as there is no organic com-

pound of silver, such as albumenate, which is really the great source of the deterioration of silver prints. We have nothing but metallic silver present, and the metal with which the tone is given. The elimination of the hyposulphites of soda and silver can be much more effectually carried out than with albumenised paper, as it is more porous. Calotype pictures fade less than albumenised prints, and hence I am hopeful regarding the permanence of the process. I may say that prints on a gelatinised surface, and on albumenised surface, can be obtained similarly, and answer fairly well.

At your meeting, when Mr. Spiller read his paper, he gave an account of the Woodbury process, and that I need not repeat now. It is sufficient to say that I hear of a modification of it introduced abroad by Mr. Woodbury, and another at home by Mr. L. Warnerke. Both these modifications consist in avoiding the necessity of resorting to hydraulic pressure to make the moulds from which the prints are taken. The present state of the process is this: a print from a negative is taken on carbo-gelatine tissue, and the image developed on a perfectly flat glass. When dry, Mr. Woodbury, in his modification, covers it with tin or lead foil in a very simple manner. He makes this the bed of an electro deposit, and, after filling it in and backing with a proper backing, the gelatine matrix is removed, and the electro is then ready to be filled with liquid gelatine. Paper is next superposed, and the excess of fluid gelatine squeezed out by means of another flat surface placed over the paper. The gelatine, when set, adheres to the paper, and the print is removed and dried, giving a mechanical print, as by the old Woodbury method. Mr. Warnerke, instead of taking an electro, uses Spence's metal for making a cast, and prints from this cast. Either of these modifications will enable any and every photographer to print his photographs by this process, without being dependent on any second party for their production. I look forward most hopefully to this simple method of mechanical printing, believing that it will materially alter the status of one branch of photography.

The Autotype Company have kindly sent some specimens of their photo-mechanical printing, the details of which I need not describe, as it is not new; but the work turned out from the printing press is now far superior to anything that has been done of late years.

Another printing process which is useful to engineers, architects, and those of like professions, is the ferro-prussiate process, which depends on the change of colour of a mixture of a ferric salt, and ferricyanide of potassium, when exposed to light. The blue colour so obtained is almost insoluble in water, and the unchanged sensitive salt is washed out by its immersion in water. I have to thank Messrs. Marion and Co., for these specimens, which I now show.

Mr. Warnerke has kindly lent me, for your inspection, samples of his photo-engraving process on copper; finer specimens I have never seen. We have, first, the original engraving; second, the photo-engraved plate; and, third, the impression from such a plate. It is impossible almost to distinguish the reproduction from the original. The process used is, I believe, an asphaltum process, and certainly gives most excellent results. We shall probably learn more about the process in the future.

An adaptation of another material to photography deserves passing mention. At the last meeting of the Photographic Society, Mr. Warnerke, and Lieut. Darwin, R.E., both showed examples of the mode of utilising a luminous image taken on a phosphorescent plate in the camera, or by allowing light to pass through a negative on to it. A surface so impressed is simply put in contact with a sensitive plate for a few seconds, and the image developed. I pass round some examples kindly furnished by Lieut. Darwin.

Another adaptation of phosphorescence is to the formation of a photometer. The stronger the light acting on a phosphorescent surface, the brighter it glows in the dark, and Mr. Warnerke has shown that the intensity of the incident light can be readily ascertained by finding what thickness of semi-opaque material extinguishes to the eye the luminosity of the phosphoresence. On this he has based a new actinometer for use by photographers, and since the radiations existing in daylight, and which are principally active in impressing the photographic image, are nearly the same as stimulate the phosphorescent material used, the principle is correct, and is an advance in the right direction, more particularly as the actinometer is not dependent in its action on any particular time for exposure of the sensitive surface to light. Where rapid plates are employed, an actinometer is absolutely essential. The completed instrument and its component parts I hand round for inspection.

I cannot but feel that what I have so rapidly sketched has been imperfect, but I have done my best in the time at my disposal. In looking to the future of photography, I see several goals to aim at. The first is photography in natural colours, regarding which I am more sanguine than most. There is no theoretical objection to it. It has been objected that the retina and a photographic plate are very different media, and that what appears as colour to one appears as something different on the other. Well, though I agree to the difference of material, I agree to nothing else. Absolute experiment has shown that true colours *can* be produced, and that the colours so produced are true pigments. If they can be obtained in the spectrum, they ought to be obtained from coloured objects—and even this has been done—and, when increased sensitiveness is obtained, there will arrive a time when anything and everything can be impressed in its own colouring. A less difficult goal to aim at is to give local intensity to gelatino-bromide negatives; and the third, to obtain even better printing processes than already exist; and my thoughts naturally turn to the platinum process for a further advance.

Regarding the diaphote, telephote, or whatever you like to call it, I am very despondent. I believe that this kind of photography is an impossibility, for the reason that one wire can never carry an infinite number of electrical impulses, which, on reconversion into chemical energy, shall give various gradations of light and shade simultaneously on a surface. The ethereal vibrations giving us what we call light are unconstrained, and vibrate on the whole of an exposed surface. These vibrations,

when converted into electrical waves, have to vibrate in a wire; hence, I see no possibility of success. A multiplicity of conducting wires is evidently impossible, if accuracy be required. The best that can be hoped for, it seems to me, is that a print in silver or carbon, placed at one end of a wire, may be reproduced at the other by some method which will closely approximate to Banes's system of telegraphy. I again assert that—as far as we can see by the eye of science at present—there is no probability of an image, reflected in a mirror at one end of a wire, being reproduced at the other end at one operation. Anything short of this would not be true telephotography.

DISCUSSION.

Mr. John Spiller said it was a great pleasure to him to find that Captain Abney had so long a list of novelties and discoveries to bring forward, which had been developed in the brief interval since he read the paper to which allusion had been made; in fact, photography might be said almost to wear a totally new complexion. The platinotypes exhibited on the wall were very beautiful, and yet the process was only in its infancy. The platinotype of the day when he had the honour of addressing them was only a mixture of silver and platinum, as to the permanence of which there might be a question, but in the finished results brought forward that evening, they might recognise the platinotype as a perfect record, which offered promise, at any rate, of very great permanence, and, as far as his chemical knowledge went, it must be regarded as a true permanent process. The novelties now brought forward were of two kinds—improvements in old processes and new discoveries. He was glad to hear from Mr. Warnerke's hopeful results of further improvements in the Woodbury type process, also to find that the autotype process was still making advances, and that in many ways old processes were moving forward; but he was still more encouraged to hear of a whole list of new directions of research in which Captain Abney himself had had the principal hand. Perhaps to no one in England were they more indebted for several new and promising researches. Many of them had already borne fruit, and he felt certain that in the future some grand results would arise out of the interesting researches which had necessarily been only briefly alluded to that evening. The establishment of a more satisfactory system of photometric record was of considerable importance. They found from the day's papers that on the previous day the sun shone only half an hour. That day it had been shining all the morning, succeeded by an afternoon of a curious hazy, yellow light, which must have given photographers some trouble. That was obvious to the eye, but he looked forward to the establishment before long of a truly scientific method of photometric record, by which they would know for certain what were the qualities of the rays which reached the surface of the earth, and the duration of the sunshine. The only other point he would allude to—and that he thought might be left in the hands of the Chairman to refer to—was the possibility of producing photographs in colours. It was a subject to which he had given considerable attention, and he was sure the meeting would like to hear Mr. Lockyer's opinion on the possibilities of the case. In common with many photographers, he had seen the results shown many years ago, but as yet it must be acknowledged that photography in colours only existed in the future.

A Member suggested that photography, especially now that it had become almost instantaneous, might be of great service in connection with medical and surgical science, in preserving an exact record of the appearance, either of diseased parts, or of the general appearance of a patient, say after a railway accident, or in hospitals.

The Chairman said it seemed to him a matter of exceeding importance that practice and theory went so closely hand in hand in this particular branch of work, and it was to be hoped, not only that Captain Abney would go on with increased vigour along the magnificent path he had chalked out for himself, but that others would step in and try to emulate him, and, for the sake of science, the sooner they did so the better. Some few years ago, when giving a course of lectures in that place on a similar subject, he had to point out how the science of spectroscopy was indebted to photography, inasmuch as by its aid they secured permanent records of the various phenomena it was essential to investigate, and he then ventured to prophecy that although photography had then done a great deal to help spectroscopy, the time would come when spectroscopy would do a little to help photography. Thanks to Captain Abney, that prophecy was already being fulfilled, for most of his results had been tested, so to speak, by application to the spectrum, either at one end of it or the other. And, looking back to the old records, reading those wonderful papers of Draper's and Herschell's, printed between the years 1837 and 1843, and the diagrams in connection with them, it really seemed a pity that so much time should have been lost; it was enough to fill the most ardent student with dismay, that what seemed now so clear and simple—because whole fields of science had been investigated since then—should have taken so long a time to discover. With regard to the future of photography, especially in the direction to which Mr. Spiller referred, he should be daring enough again to utter a prophecy. He was quite certain that photography had yet very much more to acquire from a careful study of the spectrum than it had gained already. He believed that spectroscopy would before long show those who cared to study it, especially in connection with photography, that the idea that there could be any impossibility in obtaining natural colours on a photographic plate was perfectly absurd, and arose only from our ignorance of the human eye. Since those lectures of his were delivered, some of the most important advances had been made touching human vision, which were chronicled in the history of science; he referred to the magnificent work of Krönig. If you read between the lines of the work, you would see that all the work of the human eye was done by two, or possibly three, different sets of molecules. They had already become familiar with the idea from Capt. Abney's paper, with molecules which absorbed in the red, and those which absorbed in the blue, and so on; in other words, photography had advanced from a merely chemical to a purely physical standpoint; and when they got the purely physiological standpoint put as clearly as the physical standpoint was now being put, photography in colours would be one of the simplest things, both to imagine and achieve, which men of science could conceive. Another thing which must strike every one was that, as these molecular studies advance, photography would be founding new branches of chemistry in directions where, at present, very little was done. Why should they limit themselves to silver? If these molecular groupings which you got in silver were real, depend upon it their homologues existed in connection with every other chemical element and chemical compound. Not being a practical photographer, he did not know these matters in detail, but if there was any objection to silver, no doubt copper would do as well. He had little doubt the time would come when photography in copper would be quite possible; whether it would be desirable was, of course, another matter. The point of his remarks, however, was that photography was going on hand in hand with physical science, and the two advancing side by side along the road, they were bound, in the long run, not only to make the art much more beautiful, but to make

the region of pure science a pleasure and delight to every one who looked at a photograph.

Lord Alfred Churchill, on the part of the Council of the Society, begged to thank Captain Abney very much for his excellent paper, and charming illustrations. He was not competent to speak on the scientific aspect of the question, and, therefore, would not attempt it. It was true that some years ago he studied photography a little for his own amusement, but that was in days of the wet process, and dirty fingers; and, consequently, he gave it up, but he felt very much inclined to take it up again under this new process of dry plates. He was very glad to hear so confident an opinion expressed both by Captain Abney and the Chairman, that photography in colours was probable.

The vote of thanks having been passed,

Captain Abney said he had only one duty to perform, and that was, to ask the meeting to thank the gentlemen who had so kindly rendered him their assistance by sending specimens, viz., Mr. Barclay, Mr. Warnerke, Mr. Gale, and Mr. England.

MISCELLANEOUS.

THE MINT.

The following is an abstract of the tenth annual report of the Deputy-Master of the Mint, which has lately been issued :—

The gold coinage of the year, which only occupied a part of the month of December, has been insignificant, while the amount of silver coined has hardly exceeded the average, and the bronze coinage, though larger than in 1878, has not been so great as in the two preceding years. The continued absence of a demand for gold coin has enabled the Mint to execute the whole of the work devolving upon it, with the exception of one colonial coinage entrusted to a private firm. Had the demand for gold been normal, it would, no doubt, have been necessary, as in former years, to make provision for the execution of a large part of the bronze coinage by contract; but the depression of trade during the greater portion of the year had its natural effect upon the requirements of the country, and the gold coin in circulation, with a small amount imported from Australia, was sufficient to meet the wants of the Bank of England.

The coins struck during the year 1879, were of 20 different denominations.

The total number of pieces struck at the Mint was 30,050,344, as against 24,491,230 in 1878, and their value, real or nominal, £662,664 3s.

The total number of British coins struck during the year was 27,800,344, and their value as follows:—Gold, £37,613 10s.; silver, £567,125 9s. 5d.; bronze, £45,550 3s. 7½d.

The demand for gold coin during the year, as already shown, has been very small, no gold having been sent in for coinage by the Bank of England until the month of November. This is the more remarkable, as the consignments of sovereigns from the Sydney and Melbourne Mints received at the Bank were smaller by more than a million than those of 1878, which had themselves shown a falling off of a million, as compared with the importations of the previous year. The amount of Australian sovereigns received was £1,617,000, as against £2,773,000 in 1878, and cannot be held to have had any appreciable effect upon the circulation. The coinage of gold was resumed in January, 1880, and was continued until the end of March last.

The amount of silver coin struck during the year was £567,125, as against £614,426 in 1878, and £407,822 in 1877, and the amount issued was £618,800. Of this amount £153,430 was sent to the Bank of England, £130,000 to the Bank of Ireland, and £298,470 to Colonies, £32,400 was shipped for the use of Treasury chests abroad, and £4,500 in threepences was sold direct to banks and private persons. No silver coin was issued to Scotch banks. The total issues of threepences amounted to £37,220, as against £30,425 in 1878, and, as in previous years, persons applying for small sums in coins of that denomination were referred to a London bank, which requested to be relieved of a surplus stock.

The nominal value of the half-crowns issued during the year was £151,550, and the total amount of those coins put into circulation since 1874, when their coinage was resumed, has thus been increased to £827,150.

The issues and withdrawals in Ireland have again been very considerable, and show that the renewal of the silver coinage in that part of the United Kingdom has proceeded satisfactorily during the past year. The amount issued has been rather less than in 1878, when systematic arrangements for improving the condition of the silver coinage in Ireland were first adopted by the banks, while the amount withdrawn has been more than doubled.

In Scotland, on the other hand, where steps were sooner taken to renew the silver coinage, and where both issues and withdrawals since 1872 have usually been considerable, no coin has been issued or withdrawn. This change is, no doubt, to be explained by the continued depression of trade, and by the satisfactory state of the coinage consequent upon the withdrawals of worn coin in former years.

The demand for Imperial silver coin has been greatly stimulated in colonies by the arrangements sanctioned by their lordships at the beginning of the year, under which this department has been authorised to pay all expenses connected with the carriage of new silver and bronze coin to colonies, and of worn coin to the Mint or one of its branches. The amount of new silver coin shipped to colonies in 1878 was only £69,950, whereas in 1879 it rose to £298,470, no less than £125,500 having been sent to Victoria alone, and £85,000 to New South Wales.

The average market price at which standard silver has been purchased for coinage during the year has been $52\frac{7}{8}$d. per ounce, so that, the rate at which silver coin is issued by the Mint being 66d. per ounce, the seinorage accruing to the State has been at the rate of $13\frac{1}{8}$d. per ounce, or $24\frac{13}{16}$ per cent. In 1878 the average price at which silver was purchased by the Mint was $50\frac{1}{16}$d. per ounce, and the rate of seignorage $31\frac{3}{4}$ per cent. The rate of seignorage in 1879, therefore, was nearly 7 per cent. less than in the previous year.

Notwithstanding that, since the introduction of the bronze coinage in 1860, a total amount of £1,446,000 has been issued to the public, or nearly three times the amount of the old copper coin withdrawn from circulation, the demand for bronze coin has as yet shown but little tendency to decrease.

It will be seen that the issues in 1879 have amounted to £38,570 as against £39,205 in 1878. Of this amount £28,050 consisted of pence, £7,735 of half-pence, and £3,185 of farthings, so that the issue of pence has exceeded that of the previous years, while that of half-pence and farthings has been rather less. There has been no suspension in 1879, as in some previous years, of the issue of bronze coin in the metropolitan districts, but from September to December last applicants for coin from the north of England were referred to a banking firm at Newcastle-on-Tyne, which had intimated that it held a stock in excess of its own requirements.

The bronze metal purchased during the year amounted to 100 tons, in bars ready for coinage.

The only colonial coinage executed by the Mint

during the year was a silver and bronze coinage of twenty, ten, five, and one-cent pieces for the Government of Hong Kong, of the nominal value of £10,000. A silver coinage for the Government of the Straits Settlements, of the nominal value of £8,333, and consisting of twenty, ten, and five-cent. pieces, was executed by Messrs. Ralph Heaton and Sons, of Birmingham, in the month of May, with the sanction of their lordships, and under the supervision, as usual, of this department.

The general account shows a net loss on the transactions of the Mint during the year of £27,955, as against a loss of £51,543 in 1878.

The annual profit or loss to the Mint on its operations depends, in a great measure, as has been frequently explained, on the amount of silver bullion purchased in each year, and on the amount of worn silver coin withdrawn from circulation, the bullion being converted into coin at a profit to the State, and the worn coin being purchased at its full nominal value and re-coined at a loss. The pecuniary results of each year's transactions are further affected by the amount of bronze metal purchased for coinage, and rated, as shown in the "Bronze Coinage Account," at the nominal value of the coin to be produced from it. At times when trade is expanding, therefore, and the demand for silver and bronze coin is large, the profits of the department considerably exceed its expenses, and this, it may be hoped, will generally prove to be the case. Of the eight years which have elapsed since a "Profit and Loss Account" was first compiled in the present form, the first four show a profit varying from £98,313 in 1872 to £26,435 in 1874. In 1876 there was a loss of £24,719, which was entirely due to the suspension of the coinage for nearly five months in consequence of a break-down of machinery. In 1877 there was a profit of £32,041, and it was not until 1878 that the effects of the contraction of trade manifested themselves in a falling off in the demand for coin and a reflux of large amounts of worn silver to the Mint. In that year, and in 1879, as above shown, the transactions of the department have resulted in a considerable loss, but it is satisfactory to note that, after payment of superannuation and compensation allowances, and of all expenses incurred by other departments on behalf of the Mint, the operations of the last eight years show an average annual profit of £21,117. In 1879, the profit on the coinage of silver bullion was only £25,548, as against £31,993 in 1878, while the loss on worn silver coin, including the coin withdrawn from circulation by the Sydney and Melbourne Mints, was £55,047, as against £48,959 in 1878. On the other hand, however, the profit on the bronze coinage was £35,396, and the operations of 1879 show an excess of expenditure over receipts far less considerable than that of the preceding year.

THE PRODUCTION AND COMMERCE OF LAC.

By P. L. Simmonds.

After indigo (the aggregate annual export value of which ranges from £2,000,000 to £3,500,000), another colouring and resinous substance—lac, is of considerable importance, being also attended with much less outlay in the production. The value of the lac products exported from India range from £500,000 to £750,000. From the writings of Mr. J. E. O'Conor, Dr. Carter, Dr. Brandis, Mr. G. W. Strettell, Mr. J. McKee, Mr. A. H. Blechynden, Mr. H. A. Crichton, Mr. Baden Powell, and others, we glean a great deal of information as to the production, manufacture, and commerce af lac.

Lac is a resinous incrustation formed on the twigs and branches of various trees by a small insect, the *Coccus lacca*. The trees on which it seems to thrive best are, the koosum (*Schleichera trijuga*), and the pallas or dahk (*Butea frondosa*); but it is also found on various species of *Ficus*, *Zizyphus*, and others. The incrustation formed by the insect is cellular, of a more or less deep red or orange colour, semi-transparent, and hard, breaking with a crystalline fracture. The substance is mainly formed by the female insects, which generally largely outnumber the males. Each of the females inhabits a cell, and the incrustation seems intended to serve as a nidus or protection for the ovum, and for the larva after it has been hatched.

The goodness of lac in commercial estimation depends upon the brightness of the colour and the thickness of the incrustation. This is sometimes nearly half an inch thick, completely encircling the twig. To obtain lac in its best condition, it should be gathered before the young have eaten their way out through the body of their mother. If the lac gatherer delays until they have effected their exit, the colouring matter is much diminished, and the resin is pierced through at the top. There is but little dye to be obtained from the lac in this condition. As there are two evolutions of the insect in the year, so there are generally also two gatherings, the first being in March, and the second in October. Some people, it is said, dip the lac-covered twigs in hot water to kill the young insects, it being supposed that a large amount of dye is thus secured.

In India, lac occurs in Bengal and Assam (abundantly), the North Western Provinces (sparingly), the Central Provinces (abundantly), the Punjab, Bombay, Sind, and Madras (more or less sparingly), and Burma (abundantly in some places). Lac is also found in some other countries of Southern Asia, viz., Siam, Ceylon, some of the islands of the Eastern Archipelago, and China; Siamese lac being held in high estimation. In India the best lac is obtained from Assam and Burma.

The quantities produced and utilised vary greatly in different provinces, according to circumstances, certain forests being rich in lac, which has hardly been touched, owing to difficulty of access and the cost of carriage to the place of manufacture and port of shipment.

All the districts of the Central Provinces produce lac, but it is particularly abundant in the eastern districts. Large quantities are consumed in the manufacture of bracelets (choories), rings, and beads, and other trinkets, worn as ornaments by women of the poorer classes; but most districts also export it to a greater or less extent. These provinces, at a rough guess, could readily supply some 25,000 tons of stick-lac annually.

The lac insect is as much artificially propagated, or as much cultivated as any other raw material for manufacturing purposes. The operation is most simple, consisting merely of cutting off the branch of an old tree, with the insects on it, and placing it on the branch of a fresh tree, over which and the other branches the insects soon spread themselves.

In its raw condition, incrusted round the twigs of the tree on which the insect feeds, lac is called, technically, stick-lac. The twigs are generally, for convenience of transport, brought to market cut up in lengths of two or three inches, and it is probable that a great deal of material is wasted in this process.

The objects of the manufacturer are, first, to separate the resinous incrustation from the wood; second, to free the resin from the colouring matter; third, to convert the resin into what is called shellac; and fourth, to form from the colouring matter cakes of dye known as lac-dye. The various qualities of shellac are known by different names and marks, and there is a considerable range in prices from fine orange to livery, garnet, native leaf, and button. The last quality is so named from the lac not being made in sheets, but dropped from a height, so as to solidify into masses.

In Europe, lac is chiefly used in the preparation of varnishes, and by hatters. The body of all the silk hats in common use is rendered stiff and waterproof by the liberal application of a composition of shellac, sandarac, mastic, and other resins, disolved in alcohol or naphtha

The brim is always imbued more thickly than the body with this varnish. Lac is also extensively used in the manufacture of sealing wax, which is formed of an amalgam of shellac, Venice turpentine, colophony, and colouring matter, the quantity of lac used being equal to that of all the other articles put together. Lac also enters largely into the composition of lithographic ink, and in the preparation of lake, the colouring matter being precipitated by means of alum or oxide of tin.

The great bulk of the export trade in lac is confined to Calcutta, which is the entrepôt for all the shellac (except that which is locally used up) manufactured from the raw material supplied from the forests of Bengal, as well as those of Assam, Oudh, the Central Provinces, and Burma. The latter country has lately entered the field as a direct exporter to foreign countries, and the trade of that province will undoubtedly increase. The two largest customers for Indian lac are the United Kingdom and the United States.

The appended figures show the receipts of lac in the last five years, as given in the Board of Trade returns:—

*Imports of Lac into the United Kingdom.**

	From India. Cwts.	Value.	Total from all quarters. Cwts.
1874 ..	60,944 ..	£584,647 ..	71,319
1875 ..	80,929 ..	775,070 ..	86,211
1876 ..	93,001 ..	509,546 ..	98,855
1877 ..	95,866 ..	383,130 ..	100,442
1878 ..	76,628 ..	266,478 ..	79,593

There are a few thousand cwts. of lac received from the Straits, and other countries.

The following figures give the total exports and value of lac of all kinds from India:—

	Cwts.	Value.
1874-5	76,643	254,011
1875-6	103,538	755,747
1876-7	128,712	536,976
1877-8	104,645	362,084
1878-9	91,423	298,715

The proportion of the lac dye and the resin exported is shown in the following return†:—

	Lac. Cwts.	Lac dye. Cwts.
1870-1	48,590	12,500
1871-2	58,368	17,437
1872-3	50,837	10,507
1873-4	65,896	9,902
1874-5	68,264	8,379
1875-6	92,915	10,668
1876-7	109,661	19,051
1877-8	95,075	9,570
1878-9	83,162	8,261

The above figures are for the financial years, ending 31st March.

Lac dye is now of very minor importance, both in the eyes of manufacturers and shippers, as compared with shellac. It has always had competitors in cochineal and other dyes, but lately the competition of mineral dyes has become very formidable. These aniline dyes are produced so cheaply, and are worked so easily, that they threaten to supersede the use of most vegetable dyes, and it is probable that the prospects of Indian dyes will, before long, require much consideration from the State and all interested in them.

The export duty on lac was, in 1875, 4 per cent., button lac being estimated at a tariff value of £6 10s. the cwt., and shellac at £8. On the 14th July, 1877, the duty was altered to 2s. 6d. per cwt. on button lac, and 2s. on shellac. On the 27th November, 1874, lac dye was removed altogether from the list of duty-paying articles. In India, lac-dye is mostly used to dye silk, and, to some extent, it is also employed in the dyeing of leather. It is not much used as a dye for cotton, on account of the expense. It is employed in England for dyeing cloth scarlet, as it yields an equally brilliant colour to that produced by cochineal, and one less easily affected by perspiration.

The colouring matter, which amounts to 10 per cent. in stick-lac, is reduced to 5 per cent. in shellac, the dye being carefully extracted.

* Annual Statement of the Trade of the United Kingdom. The figures are for the calendar year.

† Annual Statement of Trade and Navigation of India.

PRODUCTIONS OF THE PROVINCE OF ANHUI, CHINA.

Consul Oxenham states that many fertile regions, for which Wu-hu is the natural outlet, have begun largely to avail themselves of the facilities offered them of purchasing foreign goods. The population is increasing rapidly, and new houses of substantial build are springing up. The two great requisites of the port are capital and large warehouses; the first for purchasing wholesale the natural products of the country, and the second for storing them; as, at present, large quantities of rice, tea, and silk, for which Wu-hu is the natural port, are sent to Chinkeang and Shanghae. The productions of the province of Anhui consist of cotton, most of which article is retained at home. A large quantity is spun into thread, and then woven into cloth, the machinery, made of wood and worked by hand, bearing a rude resemblance to our own. Much is also used for lining quilts, coats, and trousers used by all except the very wealthy. The tea chiefly comes from Ching Hsien and Taiping Hsien, but much from the latter place is diverted to Kewkeang. Huichow also produces very excellent tea, and a little arrives at the port of Wu-hu. On the north of the river, Linanchow is also renowned for its tea, but it is exclusively prepared for the Chinese market, and is forwarded to Chinkeang and Yanchow in native boats. Coal also exists in many parts of the province, but the mandarins refuse to allow it to be worked. The silk has increased largely, though the total amount does not reach a high figure. The country is only beginning to recover from the effects of the Taiping rebellion. Many rich silk districts have been completely ruined, and trees have to be replanted and grow up, and population supplied, before they can recover a little of their former importance. The recovery has, however, commenced, and the opening of Wu-hu has supplied an additional impetus. The authorities are, too, interesting themselves in promoting the planting of mulberries. Foreign opium is so cheap and abundant, that no native drug is consumed, nor is it even used for purposes of adulteration. Very little is grown in the province, and that chiefly in the north, whence it is exported to Shantung and the north of China.

Tranquility has recently prevailed in the province, but secret societies abound, especially among the immigrants from Huinan, and small *émeutes* occasionally occur. In one case the Kolaohin sect attempted a rising, but were immediately put down without trouble. The most remarkable feature is the constant stream of immigration pouring in from the provinces of Hupei, Huinan, and Keangsi. Anhui was one of the chief battle grounds of the Taiping rebellion, and in the prefectures of Kinghwo and Kwangte, 90 per cent. of the population perished. They were not actually cut down and slaughtered, but the rebels seized their young men for soldiers, leaving only the old people, the women, and the children. The soil thus fell out of cultivation, whilst the rebels stopped all supplies, and the miserable inhabitants perished of starvation. Immigrating is regarded with favour by the authorities, but in many parts of the province the people, especially in the north, sturdily refuse to allow other provincials to buy their land. In many districts women are so scarce that the majority of the men have to live in forced celibacy, 100

to 200 dollars being demanded by parents before they will allow their daughters to leave. Except in Kuang-techow, where the desolation is said yet to be extreme, seven-tenths of the land has been brought again under cultivation. In April and May, many refugees from the famine districts of the north arrived, and were fed and forwarded on to the vacant lands. Rice cultivation was, however, unfamiliar to them, and on reports of bitter weather in the north prevailing, many returned. In September and October, refugees arrived from Hupei and Keangsi, driven out by the floods. Consul Oxenham mentions that the Yangtze poured its surplus waters into the Wu-hu creek from July to September, inundating an extensive tract of country. The crops down to the river were entirely destroyed, but more distant districts contrived to harvest three-tenths of their crops. During the rest of the year the people supported themselves on fish, but not till January, 1879, was the land freed from water. Inexhaustible, however, are the devices of the Chinese for extracting a living out of the most unfavourable circumstances. In their ponds they grow water lilies, the seeds, flowers, and roots of which are articles of commerce. There is also the ling-chih or water chestnut, which is largely consumed, and can be grown in a short time in the flooded fields. The revenue of the province, taken from the Chinese Red-book, amounts to 8,836,604 toels. An estimate by the tithing-office gave 18,000 families—say 85,000 persons—as the population of Wu-hu. Three streets, extending each two miles, compose the city. The number is large in proportion to the size of the city, but so many Chinese crowd into one house, that an European standard can hardly be said to apply.

CORRESPONDENCE.

ICELAND AND ITS RESOURCES.

In spite of Mr. Paterson's positive "fact" (*Journal*, vol. 28, p. 609), I still adhere to my original statement. Mr. Paterson seems never to have heard of the Theistareykir mine, the best situated of all, and one of the most important—certainly far more important than Krísuvík and Hengill, which he places first on his list. It will assuredly be surprising news to the inhabitants of Thingeyjarsysla to hear that he has "been working during the past year," and is "continuing to work," the deposits of Illiðarnámar, Kraflanámar, and Fremrinámar.

It has given me great pleasure to find that my endeavours to promote Anglo-Icelandic commerce are bearing good fruit. A very influential Icelander, Herra Eggert Gunnarsson, arrived most opportunely in this country, bent upon renewing a trade, which has been the means of raising at least one of our merchant families to the peerage. Mr. Gunnarsson has already concluded several important contracts, and I am every day being asked for introductions to him, arising out of my letter in the *Times* of the 19th inst.

Fresh evidence of the progressive spirit which is animating the Icelanders since their emancipation in 1874, has been obligingly communicated to me by Messrs. Harrild and Sons. Herra Sigmundr Guðmundsson, a leading printer in Reykjavík, has been here, studying our printing machinery, and has returned home with the first cylinder printing machine that has entered Iceland, fitted with self-acting sheet delivery, and every modern improvement. He also provided himself with type of English manufacture.

In conclusion, permit me to state that I am credibly informed that Iceland moss certainly has been, and probably still is, exported in small quantities from Reykjavík. It seems likely, therefore, that the drug was first brought to our notice by the Icelandic traders of the Middle Ages, and thus acquired a name, which has since lost much of its significance.

CHARLES G. WARNFORD LOCK.

46, Charing-cross, 22nd May, 1880.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 31ST...Society for the Protection of Ancient Buildings (at the HOUSE OF THE SOCIETY OF ARTS), 3 p.m. Conference on "The Restoration of the West Front of St. Mark's, Venice."

Royal Geographical, University of London, Burlington-gardens, W., 2 p.m. Annual Meeting.

TUESDAY, JUNE 1ST ... Royal Institution, Albemarle-street, W., 3 p.m. Mr. Fiske, "American Political Ideas." (Lecture III.)

Biblical Archæology, 9, Conduit-street, W., 8½ p.m.

Zoological, 11, Hanover-square, W., 8½ p.m.

WEDNESDAY, JUNE 2ND...Entomological, 11, Chandos-street, W., 7 p.m.

Public Analysts, Burlington-house, W., 8 p.m. 1. Mr. F. P. Perkins, "The Determination of Organic Carbon in a Water Residue." 2. Mr. G. W. Wigner, "Note on the Analysis of some samples of Chian Turpentine." 3. Mr. G. W. Wigner, "The Relation of the Scale of Baumé's Hydrometer for Liquids heavier than Water to the Specific Gravity." 4. Mr. C. Heisch, "The Acts Regulating the Sale of Poisons and Poisonous Colours in Sweden."

Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. Alf. C. Frier, "Supposed Birth-place of St. Cuthbert." 2. Mr. C. W. Dymond, "Cup Markings on Burley Moor."

Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Telegraph Engineers, 25, Great George-street, S.W., 8 p.m. Dr. C. William Siemens, "The Dynamo-Electric Current in its application to Metallurgy, to Horticulture, and to the transmission of Power."

THURSDAY, JUNE 3RD...Antiquaries, Burlington-house, W., 8½ p.m.

Royal, Burlington House (Election of Fellows), 4 p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. P. Herbert Carpenter, "The Genus, *Solanocrinus* Goldfus, and its Relations to Recent Comatulæ." 2. Mr. Marcus M. Hartog, "The Anal Respiration in the Zoeæ Larvæ of the Decapods." 3. Dr. Francis Day, "The Specific Identity of *Scomber punctatus*, Conch, with *S. Scomber*, Linn."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. W. H. Perkin "Some Products of the Oxidation of Paratoluidine." 2. Dr. A. Dupré, "The Detection of Foreign Colouring Matter in Wine." 3. Dr. E. Frankland and Mr. D. A. Louis, "The Action of Zinc Ethyl on Azobenzene." 4. Dr. E. Frankland and Mr. J. Castell Evans, "The Action of Zinc Ethyl upon Benzonitrile." 5. Mr. W. N. Hartley, "The Relation of Actinic Absorption to the Chemical Structure of Carbon Compounds." 6. Mr. Cuthbert Mison, "The Luminosity of Calcinic Sulphides."

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. William Simpson, "Afghanistan."

South London Photographic (at the HOUSE OF THE SOCIETY OF ARTS), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. T. W. R. Davids, "Buddhists' Sacred Books." (Lecture III.)

Archæological Institution, 16, New Burlington-street, W., 4 p.m.

Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Annual Meeting.

FRIDAY, JUNE 4TH...Royal United Service Institution, Whitehall-yard, 3 p.m. Rear-Admiral A. H. Hoskins, "The Defence of Our Australian Colonies."

Royal Institution, Albemarle-street, W., 9 p.m. Mr. H. H. Statham, "Analysis of Ornament."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "The Physiology or Functions of Plants." (Lecture V.) "On the Organs of Reproduction."

SATURDAY, JUNE 5TH...Workmen's Social Educational League (at the HOUSE OF THE SOCIETY OF ARTS), 3 p.m. Annual Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "The Dramatists before Shakespeare." (Lecture III.)

Institute of Actuaries, The Quadrangle, King's College, W.C., 3 p.m. Annual Meeting.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,437. VOL. XXVIII.

FRIDAY, JUNE 4, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NATIONAL TRAINING SCHOOL FOR MUSIC.—CONCERT BY SOCIETY OF ARTS SCHOLARS.

Arrangements have been made for a concert by the Society of Arts scholars at the National Training School for Music, assisted by some of the other scholars, to be given in the Great Room of the Society, on the afternoon of Tuesday, the 22nd inst. Admission will be by tickets only, to be obtained by members on application, and no person, whether a Member or not, can be admitted without a ticket. A sufficient number of tickets to fill the room will be issued to Members in the order in which they apply, and the list will then be closed. Each ticket will be numbered; it will admit one person, and will be transferable. Two tickets will be issued to each Member applying for them. Members requiring tickets should apply at once to the Secretary, stating whether a single ticket or two tickets are desired.

Should a sufficient number of applications be received, to render it desirable, the concert will be repeated on the afternoon of Thursday, the 24th inst.

The issue of Tickets will commence shortly. Until the Tickets are ready, the names of Members applying will be registered in the order in which their applications are received.

By order,
H. TRUEMAN WOOD, Secretary.

CONVERSAZIONE.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday, the 16th of June. The cards of invitation are now in course of issue.

A Vocal and Instrumental Concert, consisting of Glees, &c., by the Royal Criterion Handbell Ringers and Glee Singers, will be given from 9 to 11 o'clock, with intervals, in the Lecture Theatre.

A promenade Concert will be given by the Band of the Royal Artillery in the North Court.

The Galleries containing the Raphael Cartoons, the Sheepshanks' Collection, the Wm. Smith Collection of Water-colour Drawings, the Dyce and Forster Pictures, the Collections of Paintings lent by Lord Spencer, and by the Trustees of the late Rev. Pryce Owen, "The Chantrey Bequest," and the Schliemann Collection of objects from Troy, will be open.

The Courts and Corridors of the Ground Floors will be open. The Reception will be held in the Architectural Court, by Lord Alfred S. Churchill, Chairman, and other Members of the Council.

CONGRESS ON DOMESTIC ECONOMY.

The Council of the Society of Arts have resolved that the General Committee for conducting the next Congress shall consist chiefly of Ladies, because all the practical arrangements for giving effect to matters relating to Food, Cookery, Health, Clothing, &c., as recognised by the Education Code, are within the exclusive province of women. The Council have received the names of five ladies, Mrs. Fenwick Miller (Hackney), Miss Muller (Lambeth), Mrs. Surr (Finsbury), Miss Taylor (Southwark), and Mrs. Webster (Chelsea), members of the School Board for London, who will act on the General Committee in their individual capacities. The assistance of ladies, members of Local School Boards throughout the country, will be sought, as well as of the Principals of the Female Training Colleges, and others, who have shown an interest in Domestic Economy.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The annual Conference will be held on Thursday and Friday, the 10th and 11th June, 1880, at 11 a.m. each day, the Right Hon. JAMES STANSFELD, M.P., in the chair, assisted by the members of the Executive Committee:—Lord Alfred Churchill (Chairman of Council), F. A. Abel, C.B., F.R.S., Sir Henry Cole, K.C.B., C. N. Cresswell, Colonel Sir E. Du Cane, K.C.B., Major-General Fred. Cotton, R.E., C.S.I., Captain Douglas Galton, C.B., F.R.S., T. W. Keates, Dr. Voelcker, F.R.S.

It has been thought well that, at the Conference for the present year, the following subjects, suggested by previous Conferences, should be discussed. It must be understood that neither the Council nor the Executive Committee of the Conference

express any collective opinion on the various points which they recommend as suited for discussion :—

I.—Administrative Organisation.

1. County Boards.—The necessity for further legislation with a view to develop and strengthen Local Government administration throughout the kingdom, especially by the constitution of County Boards. [*Vide* Resolution of Conference, May 24th, 1878, *Journal of the Society of Arts*, vol. xxvi., p. 737.]

a. That such County Boards, or combinations of them, should, *inter alia*, be charged with the conservation of rivers, including the prevention of floods, and the storage of water; and be empowered to put the Rivers Pollution Act of 1876 in force upon the complaint of any local sanitary authority, or other person aggrieved, and to charge the cost of the proceedings upon the County Rate, or to sanction proceedings of any sanitary authority, or of any such aggrieved person, for such purpose.

b. That such County Boards shall appoint County Health Superintendents in each county.

2. Sanitary Districts.—With regard to the local authorities of urban and rural sanitary districts, that they should be constituted the local governing body for all purposes for which their area is fit, thus enlarging and elevating their functions; and by entrusting functions requiring larger areas to groups or combinations of such districts.

3. Election.—Election of members by ballot, instead of by voting-papers.

The holding of all local elections on one and the same day, so as to minimise the trouble and economise the time of the electors.

4. Local Government Board Inspection.—The advisability of strengthening the administrative organisation of the Local Government Board, whilst diminishing centralisation and correspondence.

a. By mapping out England and Wales into a few large areas. Each area to be under the administration of a staff of inspectors, the whole under the superintendence of a permanent Head of the Department, properly assisted, and relieved of secretarial work.

b. By instituting an Inquiry Department, for the assistance of local authorities wanting information and applying for it, charged with the investigation of scientific processes, the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained.

II.—Amendment of the Law.

1. Public Health Act, 1875.

a. Amending section 229, by omitting all the words in the first part of the section down to the words "cost or that," and enacting as follows:—"When a local authority has made default in respect of any provisions of this Act, the Local Government Board shall, after due inquiry, make an order limiting a time for the performance of their duty, &c."

[N.B.—Under this section, as it now stands, the Government can intervene only when complaint by some person aggrieved is formally made, and not upon the report of their own inspectors, however flagrant the dereliction of duty. This amounts in the majority of cases, especially where the interests of the poorer inhabitants are concerned, to a defeat of the intentions of the Legislature altogether.]

b. By conferring powers, and corresponding duties, upon local authorities with regard to the construction of sewers, and connection of house drains therewith, as extensive as those conferred upon the Commissioners of Sewers by the 11 and 12 Vic., c. 112, ss. 37, 38, and 46. [*Vide* Mr. Alcock's Resolution, May 24th, 1878, *Journal of the Society of Arts*, vol. xxvi., p, 717.]

[N.B.—These compulsory powers will apply to *old* houses as well as *new*, and authorise the local authority to do the entire work of connections from the house to the main sewer at the cost of the owners by authorised contractors, after the same manner as gas and water companies.]

c. By amending section 23, and substituting one hundred *yards* for one hundred *feet*, and empowering the sanitary authority to prevent the continuance in old, and the construction in new, houses, of any drain, sewer, or conduit within the building until an outfall for emptying the same has been provided and constructed to the satisfaction of the authority, other than into any lake, pond, river, canal, or watercourse.

[N.B.—*Vide* "Model Bye-laws," Part i., memorandum; Part iv., s. 88.]

d. By enabling local authorities in rural districts to construct new sewers and water-supply works for the special service of outlying dwellings, and necessary for their healthful occupation, and charging the cost of the same upon the owners or occupiers thereof, payment to be made within a period not exceeding twenty-one years, the intent of such provision being that rates for sanitary purposes in rural districts, including water supply, should, as far as practicable, fall on those only who are benefited by the improvements.

2. Pollution of Rivers Act, 1876.—Amendments desirable in the Rivers Pollution Prevention Act, 1876. 31 and 40 Vic., c. 75.

a. By striking out of sections 2 and 3 the word "knowingly," as superfluous and embarrassing.

b. By striking out of sections 3 and 4, the words "solid" and "liquid" respectively, and by substituting, whenever necessary, the word "matter."

III.—Sanitary Inspection and Classification of Dwellings.

Discussion of the following resolution :—

"That it is expedient that the Metropolitan Board of Works within the metropolis, and the County Board within each county, should be empowered by the Legislature to make provision for the inspection and sanitary classification of dwellings, upon application being made by the owners thereof; and to grant certificates of healthworthiness in different categories, for terms of years, according to the perfection of sanitary equipment and fitness for habitation of such dwellings; and to determine the scale of fees to be paid for such inspection during construction and repair, and also upon delivery to the applicant of the certificate of classification awarded to such dwelling."

[N.B.—The conditions and mode of granting these certificates would be analogous to the practice of the department of "Lloyd's" Association in granting certificates of class and seaworthiness to the mercantile marine.]

IV.—Further Suggestions by Sanitary Authorities.

There will be an Exhibition of Sanitary and other Appliances in connection with Water Supply,

Sewage, and Health. The Exhibition will be open from 10 till 8 on Thursday, the 8th, and from 10 till 5 on Friday, the 9th of June.

Members have the privilege of admitting two persons, either personally or by the usual ticket, on each day the Exhibition is open.

PRACTICAL EXAMINATIONS IN VOCAL AND INSTRUMENTAL MUSIC.

The Examination for the above purpose will be held at the House of the Society of Arts on Monday, Tuesday, and Wednesday next. The list of candidates is now closed, and no fresh entries can be admitted.

FOREIGN AND COLONIAL SECTION.

Tuesday, May 18th, 1880; B. FRANCIS COBB, Treasurer of the Society, in the chair.

The paper read was—

THE ARTS AND COMMERCE OF MADAGASCAR, ITS RECENT PROGRESS, AND ITS FUTURE PROSPECTS.

By the Rev. James Sibree, Jun., F.R.G.S.

PHYSICAL FEATURES OF THE ISLAND.

Two or three hundred miles away from the south-eastern shores of the African continent, the great island of Madagascar rises from the waters of the Indian Ocean. By far the largest of the African islands, it is also the third largest in the world, having a length from north to south of nearly 1,000 miles, and being at its widest part 350 miles across. Its total area is about 230,000 square miles (nearly four times as large as England and Wales), and the greatest portion is within the tropical zone; but from its physical features, as well as its sea surroundings, it has, on the whole, a much cooler and more equable climate than is enjoyed by other continental countries in the same latitude, either north or south of the equator. A considerable extent of the western and southern portions of the island, as well as a narrower strip of the eastern coast, consists of undulating plains, raised only a few hundred feet above the sea-level; but this is varied on the west by three prominent chains of hills, which run north and south. These regions are the hottest and most unhealthy portions of the island, parts of the eastern and western coast being subject to malarial fever.

But a large extent of the interior—perhaps two-fifths of its total area, from the northern apex to the 23rd parallel of S. latitude, and east of the centre—is raised to a considerable elevation above the sea, and consists of a series of plateaux, from 3,000 to 5,000 feet in altitude, but broken up in every direction by chains and irregular masses of mountains. This elevated region is cool and healthy, except in districts sheltered by hills from the south-east winds, and here, nearly in the centre of the island, is the home of the Hòvas. This tribe, the lightest in colour, and by far the most intelligent and civilised of all the Màlagàsy peoples, has, during the present century, made itself master of the greater part of Madagascar; and the central, eastern, and north-western districts acknowledge the authority of the Hòva sovereigns. This elevated portion of the country consists chiefly of primary and igneous rocks, and is, doubtless, very ancient land, as no deposits of the secondary or tertiary periods are found within its limits. The other three-fifths of the island, on the contrary, are of much more recent geologic age, and secondary fossils (chiefly of the Jurassic and Neocomian beds, as far as at present ascertained) are found over portions of its surface.* The granitic region consists largely of bare, rolling, moory hills of red clay, from which the granite gneiss and basalt rocks rise to the highest points. The great central mass of the Ankàratra mountains are, however, only about 9,000 feet in height, so that snow is never seen in Madagascar. There is little wood, except along the courses of the rivers; but there are extensive valleys where rice is cultivated.

The lower regions of the country are wooded to a large extent, and a line of dense forest forms an almost continuous belt round the island, following the coast-line, except on the north-west, where its continuity is broken, the two lines overlapping about a hundred miles. On the eastern side, the line of forest divides into two, the upper belt clothing the sides of the rugged hills, by which access is gained to the elevated interior region.

Madagascar is a well-watered country, especially on the eastern side, where the forest-clad hills catch the vapour-laden trade winds from the south-east. The rainy season lasts from November to April. The only arid portion is on the south-west, where the rainfall is scanty. But although the rivers are numerous, there are not many streams of great size, or uninterrupted depth of water; for, owing to the physical features of the interior, their courses are almost all broken up by rocky bars and sandbanks, by which navigation is interrupted. By some of them, however, access could be gained for a hundred miles, or more, into the interior, by steamers of light draught. Along the eastern coast, within a short distance from the sea, is a chain of lagoons, extending for nearly 300 miles. By a comparatively small expenditure, these could be all connected together, so as to form a continuous water-way. This work was actually commenced in the reign of Radàma I. (about 55 years ago), and it will, no doubt, at some time be carried through, and thus form a valuable means of communication and traffic between the eastern provinces.

Thus much concerning the physical features of Madagascar it seems necessary to premise before speaking of the inhabitants, and their industries, social life, and present position, in regard to civilisation and material progress.

DISCOVERY AND ACCOUNTS OF EARLY VOYAGERS.

Madagascar was known by report to the early geographers, both European and Arabian, under a variety of names; but the Venetian traveller,

* See "Nature," Aug. 14, 1879; and "The Great African Island," pp. 33 and 34.

Marco Polo, was the first to give any information as to the country and its people. But his accounts are full of inaccuracies, as he never saw the island; and it was not until the year 1506 that Europeans set foot upon its shores. On the 1st of February of that year it was discovered by Fernando Soares, a captain in the fleet of Lourenço de Almeida, the Portuguese Viceroy of the Indies; and within a few months afterwards it was circumnavigated by some of the most famous naval commanders of that nation. The Portuguese accordingly gave names to many of the chief capes and bays, and were the first to plant colonies on portions of the eastern coast. But their more important possessions at that period in the further east soon led them to abandon their Madagascar settlements; and, subsequently, the French founded several military posts on the east side of the island, especially that of Fort Dauphin at its south-east point. These, however, were not in any true sense colonies, but merely armed occupations of small portions of the coast, positions which were all eventually destroyed through the well-merited hatred of the native population, or abandoned on account of their unhealthiness. The small islands of St. Marie off the east coast, and Nossi-be off the north-west coast, are now the only remnants of French occupation of Madagascar.

Early English Intercourse with Madagascar.

Several English books and pamphlets about Madagascar were written during the reign of Charles I. In some of these the fertility and resources of the country were described in such glowing terms, that projects were set on foot for forming plantations there. One of these was under the sanction of the Government, and the fiery Prince Rupert was named as Viceroy; and a little before this, a certain "Hon. John Bond" had been appointed "Governour and Captaine-Generall of Madagascar."* But the political troubles which were then imminent in England put a stop to the projected colonisation of the African island.

About one hundred and fifty years later, the French positions in Madagascar, which were then considered as appendages of the Mascarene Islands, were ceded to England at the close of the great war, when Mauritius and Bourbon had fallen into English hands; but these positions, as well as the pretended French claims on the island, were restored to the native Government by the English, as part of the compensation made to the Màlagàsy king, Radàma I., for giving up the slave trade. Subsequently the French have claimed rights on the north-west coast, in virtue of a reported cession of certain territory to them by the Sàkalàva inhabitants; but this claim has never been allowed by the Hòva Government, nor has it been enforced by the French.

Origin and Relationship of the Inhabitants.

The Màlagàsy (as the people of the island have for a long time past been called) are, as a whole, not of African relationship, but are closely connected with the Malayo-Polynesian peoples, being, indeed, the most western representative of that very widely-spread division of the human race. This connection is shown by their physical and mental characteristics, their habits and customs and, above all, by their language, which is nearly allied to that of the Philippines, Sumatra, and other islands of Australasia. The darker races of the Eastern Archipelagoes, as well as the brown peoples, are probably represented in Madagascar; and there is also an African element, especially on the western side of the island. The country is very thinly peopled, the total population only amounting to between three and four, or, at the most, five millions, so that large portions are uninhabited, and some of the tribes are separated from others by extensive tracts of fertile, but unoccupied territory.

Until the commencement of the present century, the various tribes inhabiting Madagascar stood more on a level, as regards civilisation and advancement, than they have done during the past 70 or 80 years; although, in some tribes, certain of the native handicrafts were much more fully practised and skilfully executed than by others, who seem always to have been in a lower stage of culture.

Handicrafts.

Spinning and Weaving.—Most of the Màlagàsy races are expert in the various arts in which dexterity of hand is requisite—manufactures, strictly so called—and their long, tapering fingers look as if formed for skilled work. In the processes connected with spinning and weaving, the Màlagàsy show no small amount of skill. They make a variety of cloths, both coarse and fine, of silk, cotton, and hemp, and from the fibres of the *rofia* palm leaf, the aloe, and the banana. With rude spindles of wood and bone, twirled by the hand, they spin the thread; and then, with very simple looms, they weave the yarn thus prepared. But the weaving is regular and firm, and the fabrics produced are excellent in quality.

The coarser cloths from the fibre of the *rofia* palm, not only form the usual clothing of the poorer classes and the slaves, but they also constitute a considerable portion of the exports from the eastern side of the island. Many thousands of them, under the name of *rabànnas*, are sent to Mauritius and Réunion, where they are used for a variety of purposes. The fibre is prepared from the fine pinnate leaves of the *rofia* palm; these are stripped of the cuticle above and below, leaving a glossy, straw-coloured material, which is divided into threads of various breadths, as may be desired, by a sort of iron comb. The straw-tinted ground is varied by an endless variety of longitudinal stripes, the dyes for which are procured from coloured earths and vegetable substances. Very fine and strong cloths are also made from this fibre; some of these have the woof of cotton, obtained by unravelling English or American calico.

A very favourite cloth, called *àrindràno*, is made with a white ground of fine twilled cotton, with narrow stripes of black and coloured threads, and broad borders of black twilled silk, in which is a central pattern of colour. These form the *làmba*, or outer native dress, which is folded gracefully, something in the fashion of the ancient Roman *toga*, one corner being thrown over the shoulder. European cottons are also largely used by the

* See "Proc. Roy. Geog. Soc.," Oct. 1879; and "Great African Island," pp. 8—11.

Hòvas and the east-coast tribes, a piece the size of a good-sized sheet or table-cloth forming a very good *làmba*. These often have borders of coloured silk sewn on to the ends of the stuff.

But the skill and taste of the Màlagàsy, as regards weaving, are shown most in the handsome silk *làmbas*, which are woven by the Hòva women. These are of considerable variety of pattern and colouring (within certain conventional limits), often very rich and elegant in their effect, and with a peculiar kind of square leaf or flower introduced into the stripes, and various combinations of small diamond-shaped patterns. These silk *làmbas* form a considerable portion of the wealth of every Màlagàsy family, as they are worth from 20 to 50 dollars each. They are only worn on special occasions, such as the New Year's festival, and at marriages, &c. Dark-red silk *làmbas* are used as the outer wrapping of a corpse among the Hòvas, no coffin being employed for burial, but a great number of cloths instead. This dark-red *làmba* also forms a sort of official dress for the judges and head men of districts; and in many of them fine metal beads are woven into the stuff, so as to form a variety of ornamental patterns across the ends of the *làmba*. Almost all Hòva women, from the Queen down to the slave, can spin and weave; in some tribes, a girl is called *zaza-ampéla*, *i.e.*, "spindle child," a close analogy to our English word "spinster."

Straw-work.—But besides spinning and weaving, the dexterity of the Màlagàsy women is seen hardly less in their straw-plaiting. From the great variety of grasses, as well as from the tough outer peel of the *zozòro* (*papyrus*) rush, they plait many kinds of baskets, large and small, coarse and fine, plain and coloured, and also mats of various degrees of fineness. Among the Hòvas these are used for flooring, and lining walls and partitions, but among the Bétsiléo and south-eastern tribes, mats are the chief articles of clothing. Broad-brimmed straw hats of excellent quality are made by the Hòvas, and this is their general head-dress. A considerable variety of straw caps and head-coverings are made and worn by the other tribes, some being peculiar to particular districts. The straw mats used for clothing are sewn into a kind of sack, which is kept in its place by a girdle of bark cloth. Some tribes are especially skilful in this manufacture. The Sihànaka and Bétsiléo make mats of a great length, a number of these forming part of the yearly tribute they pay to the Central Government. The Hòvas also are very ingenious in making minute square baskets of straw, some of them not larger than $\frac{3}{4}$-inch cube, in which the plait, with beautiful patterns, is as fine as the finest weaving.

Bark Cloth.—The bark cloth just mentioned, as used for girdles, is made by the people of the south-east coast and the forest tribes; but in this branch of handicraft the Màlagàsy cannot compete with the delicate fabrics prepared from the bark of trees by many of the Polynesian races. The bark cloth of the Taimòro, Tanàla, and other tribes, is a coarse reddish-brown material, of little strength, except in the direction of the fibre; but its use, as well as the non-employment of skins for clothing, is one of the many links of connection between the Màlagàsy and the Malayo-Polynesian peoples, and serves (among many other peculiarities) to mark them off distinctly from the African tribes, who make such large use of the skins of animals as articles of dress.

Metal Work.—In metal work, the Màlagàsy also show great skill in execution and ingenuity in design. In gold and silver work the native smiths make most fine and delicate chains, and they can produce copies of any article of jewellery with wonderful exactness. Their iron work (which is all wrought, not cast) is of excellent quality, and they can also turn out brass and copper work of good finish. In the memorial churches erected at the capital (1864-1874), the ornamental iron work —finials, railings, floriated hinges, &c.—were all executed by native workmen. Among the Hòvas, the smelting and working of iron seems to have been known from a remote antiquity; and they employ the same double-piston bellows which are used in the Malayan Peninsula and Islands.* There seems to be no trace of a stone age when iron was not known to the Hòvas; although, according to tradition, the aboriginal tribe, called Vazìmba, whom they displaced in the central province, were ignorant of the use of metal, and used spears made of burnt clay, and of the tough wiry bark of certain palms.

Pottery.—In fictile art, the Màlagàsy are not so advanced as are many peoples, who, in most other things, are their inferiors. Perhaps, however, this arises from the large use made by many of the tribes of vegetable substances and leaves for plates and dishes and waterpots, so that the necessity for articles of pottery has not been felt; and also from the absence in the maritime plains of suitable clays. Amongst the peoples who live in and near the forests, wooden dishes are largely manufactured; and the forest and coast dwellers also use the leaves of the pandanus, the banana, and the travellers' tree for holding food and liquid; while the jointed and chambered bamboo supplies them with vessels for drawing and storing water. Dishes of finely woven straw or rush are also employed. But, in the central provinces, where vegetable materials are more scarce, and where clay is abundant, pottery is manufactured, and water vessels of various kinds are produced, as well as rude dishes, plates, and cooking pots. A special kind of vessel, made for cooking the beef at the New Year's festival, is elegant in shape—much like some of the Anglo-Saxon pottery now and and then found in ancient "barrows," both in ornament and outline. Some of the water jars are of fine quality, and deep red in colour, like Samian ware.

The horns of the fine, humped cattle are manufactured into a variety of articles, especially spoons, dishes, and plates. Almost every tribe has some special pattern of wooden spoon peculiar to it, some of which are very elegant, and beautifully finished. They are often ornamented with various devices burnt in on the handles.

Building.—In the building art, the Màlagàsy, as a whole, have made but little advance, beyond constructing the small and simple dwellings required by a semi-civilised people. Except in the central provinces, the houses are constructed almost entirely of vegetable materials, and without any metal fastenings, all being tied together with tough, fibrous plants. But, in the interior, especially in

* See Tylor's "Early History of Mankind."

the Hòva province of Imérina, houses are built of layers of the hard red clay which is so abundant; and this, when properly prepared, forms a very durable material. The chiefs and wealthy people used also to build framed houses of timber planking, with enormously high-pitched roofs, covered with shingles, tiles, or thatch of a triangular rush. The royal palaces at the capital, Antanànarìvo, are remarkable structures, the largest being about 120 ft. high to the ridge; and this was formerly entirely surrounded with an immense verandah in three stages, now replaced by stonework, with corner towers.

Recent Advances in Arts of Construction.

But great advances have been made in this direction, as well as in many others, during the last 16 years, since the country has been opened up again to Europeans. In 1863, the writer commenced the erection of the first of the four Martyr Memorial Churches at the capital city of Antanànarìvo for the London Missionary Society; and the construction of these stone buildings, in European style (Gothic and Byzantine in design, with towers and spires, &c.), formed a training-school for workmen in all the branches of the building art. A considerable number of stonemasons, carpenters, tilers, blacksmiths, and glaziers, there learnt how such work should be done. At the same time, the use of sun-dried brick was introduced, and the old laws (connected with idolatry), forbidding the buildings in the chief towns to be of any material except wood, having been repealed, a great impetus was given to the erection of new houses. The result of this has been that, in the space of about ten years, the capital city of the country has been rebuilt; substantial houses of sun-dried brick, with European arrangement of rooms, fireplaces, &c., have replaced the old-fashioned timber houses, with their high-pitched roofs, and long gable timbers or "horns." A considerable number of public buildings have also been erected, including new palaces for the Sovereign, a magnificent building for the Prime Minister, houses for many of the nobles and chief officers of Government, a Chapel Royal, a hospital, college, normal schools and printing offices for the London Missionary Society, as well as a number of large churches in connection with that society, in the capital and its suburbs. Besides these, throughout the numerous small towns and villages in the neighbourhood of Antanànarìvo, three or four hundred village churches have been built, many of which, with their neatly finished interiors and simple arrangements, are models of what such structures should be. Their lofty tiled or thatched roofs rising over the houses now make quite as conspicuous a feature in the landscape in Imérina, as does the parish church tower or spire in the villages of England. The vast majority are in connection with the above-mentioned society; and most of the larger buildings, both for the Government and great officers, and for the Christian congregations, have been designed and superintended by Mr. W. Pool, to whom, as well as to the late Mr. James Cameron, the country owes a debt of gratitude for the help they have given to its material progress. Some other mission agencies have also good buildings, the Society for the Propagation of the Gospel and the Norwegian Society having each a hospital, and the latter a church and schools; while the Roman Catholics have four churches in the capital, one of which, now nearly finished, is a very elegant stone edifice, and several others in some of the neighbouring villages. The last-named mission, chiefly by means of its French lay members, has largely made use of pounded and compressed clay for its buildings, a material, in some respects, even better than sun-dried brick.

The civilising influences just described, are most largely seen in the central province of Imérina, and also, but in a less degree, in the southern province of Bétsiléo, and at a few points on the eastern coast.

Roads, and Means of Communication.

With regard to roads, and means of communication from one point of the country to another, Madagascar is still very backward. A road, in the European sense of the word, can hardly be said to exist anywhere, and consequently, wheeled vehicles are almost unknown. Of course, there are paths, which are merely narrow beaten tracks, to and from the chief places; and along these all goods are carried, on the shoulders of the native bearers, as well as all travellers. The national carriage is a slight open, palanquin, or *filanjàna*, as it is termed; a light seat of iron framing, padded and covered with leather, attached to two slender poles, which are carried by four men, two abreast in front, and two in the rear. A lady's *filanjàna* is an open, oblong basket, carried in the same way, and with a simple cloth covering for long journeys. On the open plains, the paths are passable enough, but through the forests they are often frightfully bad, and sometimes almost impassable, from the deep sloughs of mud in the hollows, and long slippery ascents and descents among the hills. The celebrated traveller, Madame Pfeiffer, not inaptly described the Madagascar paths, when she said that in most countries roads were intended to help on the traveller, but in Madagascar they were intended to keep him back! It should be said, however, that foreign interference has been one of the chief reasons which has led the Government to leave the roads in such a condition. For more than 200 years past the French have been making attempts to gain possession of Madagascar, and the Màlagàsy have not unnaturally felt that the dense forests surrounding the central provinces have been their chief safeguards against an invading force; and so they have left the paths almost as Nature has made them. The Hòva King, Radàma I., used to say that he had two officers in whose hands he would leave any enemy attempting to ascend into the interior, viz., General Hàzo and General Tàzo, *i.e.*, Forest and Fever. But the Government is now enlightened enough to see the advantage to the country of improved roads, and a commencement has been made in the capital city, and good roads are to be constructed along some of the chief routes. Along the rough forest paths, however, a considerable amount of traffic does pass. Great quantities of European goods are brought up from the coast; and hundreds of thousands of hides, thousands of cattle, and great numbers of poultry are taken down to the ports; while all along the coast the produce of the country is collected by numerous creole and foreign traders.

Canoes and Boats.—Water-carriage is largely made use of on the rivers and coast lagoons. The native canoe is made of the hollowed-out trunk of a tree, chiefly the *varòngy* (*Calophyllum inophyllum*), and some of the canoes are forty feet long, with about three feet beam. On the south-east coast, a native boat, called *sàry*, is used. This is a built boat of planks, but no iron is used in its construction, everything being tied together by the wire-like fibre of the *anìvona* palm, while the holes are plugged by tree-nails of hard wood. The seams are caulked with strips of bamboo, and loops of the same material form rowlocks for the larger oars. The seats pass right through the sides, and thus stiffen the whole, and bind it together, for there are no ribs or framework. These boats rise up at the stem and stern, and will carry 50 people, or a large quantity of goods. They are used for going out to the shipping through the heavy surf, where no canoe could possibly venture. These ingeniously made boats have evidently been in use for a considerable period, as they are referred to by some of the earliest French books on Madagascar, written from 150 to 200 years ago. On the west coast outriggers are adopted, and canoes fitted with these and with sails venture out to sea in a very fearless way. The natives along that portion of the island are bold navigators, and until the early portion of this century, they were accustomed to make an annual piratical expedition to the Còmoro Islands, in which hundreds of canoes, carrying thousands of men, were employed. Most of these must, therefore, have been boats of considerable size and seaworthy properties.

Markets.

A prominent feature in the commercial life of the Màlagàsy, is their system of great markets throughout the central provinces. At the capital city, and at or near all the more important towns, markets are held on some day every week. At these places, all in the open air, several thousand people assemble from the neighbouring towns and villages, and there almost everything that grows, or is manufactured or imported in the country, can be purchased, some markets being specially noted for certain articles, as timber, thatch, cloth, &c.

Cultivation of Rice.

In few things is the industry and ingenuity of the Màlagàsy shown more than in the cultivation of rice. This grain is the staple food of the people in the central and eastern provinces, and "to eat rice" is, therefore, the native equivalent of the phrase, "to have a meal." The majority of the rice produced is transplanted. The grounds where it is sown broadcast, are narrow strips of land along the sides of streams, where the water can be led over the young plants; or, more commonly, a series of terraces in the hollows between the hills. These often form an immense green staircase, down which a stream flows gradually from one terrace to another. The water for irrigation is frequently brought from a considerable distance, and is led with great ingenuity round the hill sides, and over depressions by rude aqueducts, showing some practical knowledge of hydrostatics. The Hòvas are very ingenious in this agricultural engineering, but they are surpassed by the Bétsiléo in the south, where the elaborate care and skill employed to utilise not only the hollows but also the convex surfaces of the hill sides, often filled me with admiration. When the rice plants have grown to a height of from six to eight inches, they are taken up and carried down to the rice-fields proper in the broader valleys and plains. Each of these fields is so arranged that a stream of water can be brought over it; and the ground having been previously dug over, manured, and softened with water, until it becomes a soft mud, the plants are planted out by the women or female slaves, being stuck into the ground with marvellous rapidity, so that half-a-dozen girls will plant a large field in a very short time. Here the rice grows until it is ripe, water a few inches deep always standing in the fields.

Some of the forest and coast tribes do not prepare the land in this way, but sow on ground which has been merely trampled over by oxen, and other tribes again plant on the hill sides, where the woods have been burnt down to form clearings.

Other Vegetable Products.

Besides rice, a number of roots and vegetables are also cultivated by the Màlagàsy, the manioc root or cassava forming a considerable portion of their food, as well as yams, sweet-potatoes, beans, millet, Indian-corn, &c. The sugar-cane is also cultivated, and in the warmer districts grows to a great size. A coarse sugar is made, but, except in the neighbourhood of the capital, the cane is chiefly used for the manufacture of a spirit called *tòaka*. Coffee, spices, ginger, chillies, tobacco, indigo, hemp, and cotton are also grown, but not in large quantities. There is a considerable variety of fruit, many kinds being indigenous, as the banana and plantain, pine-apple, loquat, grape, citron, lemon, mulberry, raspberry, &c., and others introduced by Europeans, as the peach, mango, pomegranate, guava, and fig.

Before considering the future prospects of Madagascar, looked at as a possible field for European settlers, and as a country able to supply largely many tropical productions, a word or two may be said as to its present position as regards Government, and its intellectual progress.

Political History.

Until the commencement of the last century, there appears to have been no one tribe in the island having any great preponderance over another. The inhabitants were divided into a great number of small and independent States, each under its own chieftain, and often separated from other tribes by a tract of uninhabited country. In the early part of the eighteenth century, however, a small, but warlike, tribe in the south-west, called Sàkalàva, conquered all the people on the west side of the island, and also some of those in the northern central region, including the Hòvas; and then established two kingdoms, which retained their supremacy for about a hundred years. But towards the beginning of the present century, the Sàkalàva power was weakened, and the Hòvas in the central province threw off their yoke, and conquered their former masters, also subduing the eastern, and most of the central tribes. In this enterprise, the Hòva chieftain, Radàma I., was aided by the English Government, which was then anxious to stop the exportation of slaves from Madagascar. In order to accomplish this, they

gave a yearly subsidy to Radàma—in whom they saw the most capable and influential of the native chiefs—and he, by the arms and ammunition and European training he obtained for his troops, established his supremacy; so that from that time the Hòva sovereigns have claimed the sovereignty of the whole island. As a matter of fact, about a third of the island, chiefly the west, and especially the south-west, is practically independent. But it would doubtless be a benefit to the country as a whole were the Hòva—now becoming enlightened and civilised—to be firmly established over the tribes of the north-west, who are perpetually at war with each other, and whose barbarism prevents all progress in that part of the country.

Establishment of London Missionary Society Mission, in 1820.

Radàma I. was a most enlightened man for his time, and gave every encouragement to the missionaries of the London Missionary Society, who commenced work in his capital in the year 1820. These men were the first to reduce the native language to a regular system of orthography, and to give the people their own speech in a written form;* they founded a school system, by which many thousands received the elements of a good education; they prepared numerous books; and, besides the planting of Christianity in Madagascar, the lay members of the mission also introduced the knowledge of many of the arts of civilised life, teaching the people improved methods of iron-working, carpentry, and masonry, as well as instructing them in tanning, the manufacture of bricks, tiles, pottery, and soap, and of many sulphates, carbonates, and nitrates used in the various arts and in medicine. They also discovered limestone, slates, and stones suitable for grindstones, and a metallic sulphate from which sulphur could be extracted, and they constructed several useful engineering works in the neighbourhood of the capital. The processes of printing, bookbinding, and lithographing were also taught to a number of native youths. It will be evident, therefore, that in addition to the main object of the early mission work, the teaching of Christianity, the first missionaries did not a little for the material advancement of the people. And, from what has been already said as to the recent progress in all the building arts, it will also be seen that the present mission has not been unmindful of the traditions of its predecessors.

Period of Retrogression, from 1836 to 1861.

The bright prospects of rapid advancement for the country which were then opening up, were, however, darkened by the death of the King in 1828, and by the accession of one of his wives, the Queen Ràvalona I. The new Sovereign was strongly attached to the old idolatrous customs, and somewhat prejudiced against foreigners, apart from their religion. And although, from her appreciation of the material benefits the missionaries had brought to the kingdom, she permitted them to stay for a certain time, yet, one after another, they were all at last obliged to leave, until, in 1836, the last two also left, and the mission and its civilising work was entirely broken up. For 25 years from that time European influence was, as much as possible, excluded from the country: severe persecution of Christianity was again and again resorted to, and, owing to an unfortunate collision with the English and French naval forces at Tamatave, in 1845, almost all commercial intercourse was stopped between Madagascar and the Mascarene Islands for several years. Meanwhile, the condition of the country was most deplorable; frequent wars, often carried on with great cruelty, were desolating many of the distant provinces, and but for the irrepressible influence of the Christianising and civilising work already done by the London Missionary Society's mission, Madagascar must have relapsed into its previous semi-barbarous condition. But, happily, although persecuted and repressed, it could not be destroyed; and, at length, when the death of the Queen occurred in 1861, the "dark ages" of the great island had for ever passed away.

Resumption of Mission and its Civilising Work in 1862.

During the following year the mission of the London Missionary Society was re-established at the capital city, educational and literary work was resumed with vigour, and for several years made steady progress in Antanànarìvo and its vicinity. Subsequently other Protestant societies, the Society for the Propagation of the Gospel, and Church Missionary Society, opened missions on the eastern coast, and a mission of the Society of Friends joined the London Missionary Society in the interior. In 1863, the work of building the memorial churches, hospital, &c., was commenced, together with those improved methods of construction already alluded to.

Further Advances in 1869.

But in 1868, and the following year, a considerable advance took place. The accession of the present Sovereign, Ranavàlona II., and her open adhesion to Christianity, gave a great impetus to the movement forward, which had been steadily going on during the reign of her immediate predecessor, Queen Ràsohérina. The burning of the royal and national idols (September, 1869) was the signal for almost the whole population of the central province of Imérina to put themselves under instruction. This was also the case, but to a less extent, in the southern province of Bétsiléo, for there the people had had far less of teaching than their neighbours to the north; and wherever the Hòva influence extended into the distant provinces, there also some educational work was begun. During the last ten years, therefore, the progress made in the central provinces has been very rapid in many directions. Throughout Imérina and Bétsiléo, hundreds of congregations meet together for Christian worship, and at the majority of these there is a school for village children. These are being gradually supplied with efficient teachers from the training schools in the capital. In 1879, the number of schools was 890, with about 50,000 scholars. The Queen and her Government take a great interest in education, and are constantly urging on the people the necessity of sending their children to learn. In Antanànarìvo there are a number of excellent schools, together with a college and normal schools for the

* See Rev. W. E. Cousins, on "The Málagàsy Language," Proc. Philol. Soc. 1878.

training of teachers. There is, therefore, a considerable reading class in the central provinces, and their desire for knowledge is supplied by a quantity of literature constantly issuing from the presses of the London Missionary Society, and the Friends Missionary Association. Several periodicals are issued—monthly, bi-monthly, and quarterly—some being illustrated by wood engravings sent from England, and some by lithographs executed by native youths, and these have a large circulation. There is also, now, a considerable number of valuable books in the native language, including school books, science text-books, Bible dictionaries, commentaries on the Scriptures, &c.

These enlightening influences are at present chiefly at work in the two central provinces, for the numerous other tribes inhabiting Madagascar have not yet advanced much beyond the semi-civilised state in which they have remained for centuries. But as mission stations have now been formed among some of the more heathen tribes, and a native missionary society is also sending out educated Christian Màlagàsy into some of the distant provinces, there is reason to hope that in time, enlightenment will spread throughout the whole island.

Government.

As regards government, Madagascar must be called an absolute monarchy, as there are no representative institutions; but the Queen is assisted by a prime minister, and other officers of state, between whom the business of the kingdom is divided; and the present sovereign professes to rule "by the favour of God and the will of the people," and in accordance with a printed code of laws. Practically, there is a considerable amount of contentment and happiness among the people, notwithstanding many evils inseparable from the political state in which they and their fathers have lived for so long. Very recently, various measures have been adopted to improve the administration of justice, and appoint men of good character and ability to important posts. The distant provinces are governed by Hòva military officers, selected by the central Government, and the Hòva authority is maintained by small garrisons at all the chief ports and principal interior towns. There is an army of several thousand men, which was first trained and drilled by English officers in the time of Radàma I., and, more recently, by both English and French serjeants. The tendency of things lately has been to break down somewhat a kind of feudal system which had been in force, and to centralise all authority. As the people grow more enlightened, this will again, probably, lead to something more like a representative system than is yet practicable.

Slavery is a prominent feature in Màlagàsy society; but it is really a "domestic institution," and is marked by few of those repulsive features which it wears in countries where the colour prejudice intensifies the difference between master and slave. An inroad has, however, been made into the slave system by the emancipation, in 1877, of one great division of the slave class, the Mozambiques, or African slaves and their children brought into the country. As Christian feeling gains power, other advances will, no doubt, eventually take place.

It will, perhaps, now be asked, "What prospect is there of Madagascar taking a place among the produce-supplying countries of the world? and what openings are there for European skill and capital?"

Madagascar as a Produce-supplying Country.

In reply to the first of these questions, it will have been already inferred from the facts given above, that the country is capable of supplying many of the most valuable products of the tropical zone. Rice, sugar, coffee, and spices, silk, cotton and hemp, indigo and tobacco, might all be produced in practically unlimited quantities. At present, however, rice, sugar, and coffee, are the only articles out of this list which are grown for exportation. The cultivation of coffee is yearly increasing, and numerous small plantations have been formed along the shores of the east coast rivers by Creole traders. For several years past large quantities of gum-copal and india-rubber have also been exported, but owing to the reckless manner in which the trees supplying the latter have been cut down, it is feared that the whole trade will come to an end before long unless some steps are taken to remedy the evil. In the southern part of the island, a lichen, called *orseille*, which is valuable for dyeing, is collected in considerable quantities.

Chief Exports.

The most important item of export at present is cattle. The colonies of Mauritius and Bourbon derive their entire supply of beef from the fine humped oxen which are shipped by thousands from the eastern ports. Very lately, however, the trade is said to be leaving the eastern side of the island, the ships fetching the cattle from the north-west coast, owing to their greater cheapness in the Sàkalàva country. A considerable trade has also sprung up between the south-west ports and Natal. Hides are sent down in large quantities from the interior, being dried and salted for exportation. The valuable woods found in the forests would also form an important article of trade were they allowed to be exported, but at present it is forbidden by the native laws to export timber. Ebony and numerous hard and beautiful woods resembling teak, rosewood, and mahogany, are found in the forests, and are used for cabinet work, and in building, and also in making the parquetry flooring in the best class of houses. The exports and imports of Madagascar, and their annual value, will be seen by the following extracts from the English consular reports; these, however, only refer to the goods in British ships, and from the eastern side of the island; and I regret that I have been unable to procure any information later than the dates here given:—

Exports and Imports.

Year.	Imports. £ s. d.	Exports. £ s. d.
1870	57,922 13 10	..... 63,047 3 5
1871	105,595 12 4	..... 88,230 8 2
1872	154,659 11 9	..... 145,258 8 8

Of the imports in 1872, the chief items were—Cotton goods (£47,899); specie (£56,678); rum (£20,262); haberdashery (£8,103); and hardware (£4,701). Of the exports for the same year—India-rubber (£65,152); oxen (10,971, worth £46,059);

hides (£8,567); rice (£6,691); sugar (£5,336); gum-copal (£3,466); straw bags (£2,012); and ralanas (£1,024), were the principal articles. The Consul estimates the number of French merchant vessels visiting the east coast during the year at about two-thirds of the number of British ships, so that the total value of the exports and imports for the year 1872 would be about £257,000 and £242,000 respectively for the eastern coast. If to these sums we add two-fifths more of the western coast traffic, we shall probably not be far wrong in estimating the total value of the commerce of Madagascar at that date at about £300,000 inwards and outwards.

Prospects of Increased Exports.

In conclusion, it will perhaps be asked, if the country is so fertile, cannot all its valuable productions be supplied in much greater quantities than they now are? One reason for doubt is that a much larger supply of labour is not at present to be procured. The country is thinly populated, and the people are not much disposed to work in large plantations, but prefer their village life, each man cultivating his own rice field, and working his own plot of manioc, indian-corn, or vegetables. The want of roads also makes it unprofitable to convey produce for any great distance. Besides this, there must be a much greater advance in knowledge and in power of combination, as well as increase of available capital, before the natives of Madagascar are likely to undertake, on a large scale, the production of such articles as would find a European market.

Difficulties in the way of Foreigners Obtaining Land.

It may perhaps be further inquired why Europeans do not obtain land, and form plantations. The reason is, that the Màlagàsy are strongly opposed to the sale of land to foreigners, and in their treaties with England, France, and America, have stipulated that land is not to be sold, although it may be rented for a term of years. No periods are, however, mentioned, and hitherto the Government has not been disposed to grant facilities for obtaining lengthened leases.*

This may, at first sight, appear narrow prejudice on their part, but looked at from their point of view, it shows no little political sagacity. The Màlagàsy very naturally wish to retain their country in their own hands; and they know well enough, from what they have heard of the history of European aggression in other parts of the world, that if foreigners once obtain a footing in a country occupied by one of the darker races, they sooner or later become the dominant power in that country. "Madagascar for the Màlagàsy," is surely a natural and reasonable sentiment, and we, as Englishmen, taking a pride in our island home, ought not to have any feeling but one of admiration for the love of their own island shown by the Màlagàsy, and their desire to retain it as their own. We, at least, with our extensive colonial possessions, and almost unlimited openings in various parts of the world, need not look with any covetous eye at this African island. As it is, Madagascar is one of the few places with which they have had to do which Englishmen can regard with almost unmingled satisfaction. We have not, then, taken from the native owners a single inch of territory, either by the strong hand of force, or by any underhand proceedings. Our influence has indeed been powerful, but it has been exerted to enlighten and civilise and Christianise its people; surely a greater glory to us than if we had obtained possession of the whole island, and were there, intentionally or not, improving the lawful owners of the soil from off the face of the earth. More than that: but for the influence of England, Madagascar would probably have long ere now fallen into the hands of the French, who have been making various pretended claims to it for more than 200 years past.* Happily, however, a few years ago, an understanding was arrived at by the English and French Governments, that each should respect the independence of Madagascar. May that agreement always be respected; and although our most recent news from the country informs us that the newly appointed French Consul was apparently doing his best, or worst, to force a quarrel with the native Government, let us hope that this is only a little "gasconade" on the part of a new official, and that it will not be permitted to the French to repeat in Madagascar the shameful proceedings which resulted in their acquisition of Tahiti. It would be discreditable, indeed, if in this African island the influence of any European nation were employed to overpower the national feeling of independence growing up among its people, and to bring them under a foreign yoke, and so prevent that quiet, steady development from within, which has marked the history of Madagascar for the last few years, and which will continue if the country is free from foreign interference.

As regards its scientific aspects (which cannot be appropriately considered in this paper) Madagascar has numerous points of extreme interest; its physical geography and geology, its luxuriant and still imperfectly known flora, its peculiar and exceptional fauna, the origin and divisions of its people, their language, superstitions, folk-lore, and customs; all these are subjects in which it offers very much worthy of investigation. But it has better claims upon our attention than even these offer, for, while we cannot expect Madagascar soon to take a very important position as regards the commerce of the world, as a produce-supplying country, or regard it as a probable field for English colonisation, it appeals powerfully to our sympathy as well-wishers to our fellow-men. For it is a country where, not long ago, the Sovereign, at her accession (as she has done frequently since), publicly announced that "her kingdom rested upon God;" where the people have already made great progress, and are yearly advancing in intelligence and civilisation; and where, with the helping hand of Christian Englishmen, to guide and counsel them for a time, they will at length become strong and self-supporting, and, by the blessing of that overseeing care which guides nations as well as individuals, will develop into a united, intelligent, civilised, and Christian people.

* The Creole coffee-planters obtain their land chiefly by marrying native women, and work it by the employment of slave labour, thus really evading both the native laws and those of their own country—England or France, as the case may be.

* "Madagascar: Possession Française depuis 1642," is the title of a French work by M. Barbié du Bocage; Paris, 1858.

DISCUSSION.

The Chairman regretted that the writer of the paper, in consequence of his recent departure for India, had not been able to be present himself to read it. The subject was very important, more especially in its commercial aspect. Many of the products of Madagascar had lately received considerable attention, both on account of their peculiar character, and of their usefulness. The value of the exports from the island, as shown by the statistics given in the paper, was very large, and it was in some measure to be regretted that these were not carried further than 1872. If Mr. Sibree had been able to carry them on later, it would have been found that a very considerable trade had since arisen, especially in the direction of the Mauritius, whose inhabitants drew their supplies of cattle almost entirely from Madagascar. A great number of gums were known to exist in the island, but their commercial value had not yet been ascertained. Among others was a gum, said to be the cowrie gum, which, no doubt, only required to be dug up in sufficient quantities to form another valuable article for export. The peculiar formation of the hill country showed that it was admirably adapted for coffee-growing, and in the warm plains there could be no doubt that the sugar-cane would flourish, and yield a valuable product if properly cultivated. There was, therefore, every reason to anticipate that, when next the commerce of Madagascar came to be discussed in that room, much of the advance hoped for by Mr. Sibree would be found to have taken place. The Society was much indebted to Mr. Sibree for his paper, which was the more valuable, as it was derived almost entirely from his own experience in the island, which, as the meeting was aware, was such as to give all his statements very great weight and authority.

Mr. Richardson desired to say a few words on the interesting paper prepared by his brother-missionary, Mr. Sibree. He had listened to it with very great pleasure, but would have been glad could the meeting have had before it Dr. Mullins's more recent map of Madagascar, as it would have enabled them to form a more correct impression of the geographical and physical features of the island. Mr. Sibree having lived for a long period in Madagascar, was a very competent authority to speak of it, and his paper might be certainly accepted, as on the whole, correct. He (Mr. Richardson) might say, that those who had lived in the island as long as Mr. Sibree (his own residence there had extended over more than 10 years), would entirely accept Mr. Sibree's paper, with but very slight modifications. With regard to the Chairman's remarks about the exportation, he thought, alluding to the export of cattle, that Mr. Sibree was quite correct in saying that the exportation had decreased from the port of Tamatave on the east coast, and the reason was, that it was a very difficult journey from the central portions of the island to the east coast, occupying for the transport of cattle some two or three weeks, and there was, in addition, a tax imposed on the cattle of a dollar per head, whereas along the west coast where the tribes were practically unsubdued, bullocks might be bought (if they would excuse the expression) for a mere song. He had himself bought three bullocks for £1, and he afterwards sold the hides, and gave the flesh and bones, which were worth a few shillings, to the men who accompanied him. The decrease in the traffic of Madagascar from that port for the last few years had arisen from the fact that the traders could get bullocks at a cheaper rate from the west coast than they were able to obtain them on the east. It was stated in the paper that the small island of St. Marie's was now the only remnant of the French occupation of Madagascar; but the French also possessed another island on the east coast, and a very important trade was carried on with that island which was known as Nonsobayé. Steamers brought produce every month from Nonsobayé to Zanzibar and Aden, whence it ultimately reached England. Certainly, as remarked in the paper, there was great danger of the French establishing themselves in Madagascar. The priests were very influential, and the French consul to whom Mr. Sibree referred, had lately done some very questionable things; but the Government of Madagascar had got the better of him of late; and the recent excitement appearing in the newspapers on the subject, might now be dismissed, as he believed any differences between ourselves and the French would be amicably settled. Mr. Sibree had a little failed in drawing attention to one of the recent signs of progress in Madagascar. It should be remembered that some few years ago, there were not 3,000 readers in the island, but in consequence of the efforts of the Missionary Societies, the Roman Catholic Society, and the Lutheran Society, which were all working there, no less than 50,000 persons in the island were now able to read. That was a great hope for the country. It should not be forgotten, in considering the affairs and the immediate future of Madagascar, that the central Government in Antananarivo was really as far removed from some of the stations, practically speaking, as London was from New York, or even from San Francisco or Shangai, looking at the difficulty of communication and access, so that progress must naturally be somewhat slow. Above all, the Madagascar Government believed that the French had designs upon their country, and for that reason they considered it was to their interest not to facilitate communication, but to keep the roads bad, and, in fact, everything was done to keep foreigners out of the island. But they manifested a great respect for Englishmen; they knew that we have no designs on Madagascar, and were willing to submit to our influence. Still we must be content to wait for many years before we could see Madagascar develop into a food-producing country, and rise in the scale of nations. We must remember that Christianity had only made itself really felt in the island during the last ten or twelve years. On the other hand, the husband of the present Queen was a most intelligent and high-minded man, and was labouring in the interests of the people. He might state, as evidences of advancement, that the Queen had founded an hospital, and had now two European doctors in her employ, one at £400 and the other at £180 a year, and she had done all she could to encourage her people to enter the churches and to learn to read. She had also amended the laws of divorce, and abolished polygamy; and, by a late proclamation, she had further abolished the conscription for military service for life, and made it binding, universally, for the space of five years only. He had every hope in the Queen and Prime Minister of Madagascar, and believed that ultimately the country would become of very great importance in the history of the world. But we must have patience with them, and if we could only get Christian traders and travellers to penetrate through the country, they would have even greater influence than the missionaries. It could not be denied that at present the Government of Madagascar did not hold out many inducements to foreigners to go into the island, but the reason was their fear of the French. He would say, in conclusion, again, that all Mr. Sibree had said might be accepted generally as correct. If Mr. Sibree could have been present he would, most probably, have extended some parts of the information. Personally, he had been delighted with the paper, and hoped that it would succeed in drawing attention to the very interesting subject of the present condition and future prospects of Madagascar.

The Chairman proposed a cordial vote of thanks to Mr. Sibree for his interesting and valuable paper, which was passed unanimously.

MISCELLANEOUS.

BEAUMONT COMPRESSED AIR-ENGINE.

The value of compressed air as a motive power has long been recognised, and many attempts to utilise it in this respect have been made, although hitherto they have not always been attended with practical success. The main difficulty which has stood in the way of inventors and has retarded the progress of the air-engine has been that of providing means whereby the full power contained in the air under compression can be utilised economically and at serviceable pressures. Judging from the results of some experimental runs made with an air-driven locomotive which we recently attended, this difficulty would now appear to have been mastered, and highly-compressed air to have been rendered practicably available as a source of motive power. This has been effected by Colonel Beaumont, R.E., in an engine which has been lately running in the Royal Arsenal, Woolwich, where its powers have been put to the test of practical work. It is now some four years since Colonel Beaumont first commenced experimenting in this direction, and he has proceeded step by step, improving and perfecting as he went on, until he has at last succeeded in producing the engine in question. The construction of this engine is based upon the principle of utilising the entire power stored up in compressed air, no matter how high the pressure may be. This is effected by admitting the air into successive cylinders, having different areas, commencing with the smallest, and in making provision by which as the pressure falls in the reservoir the consumption of air can be increased. In other words, the elasticity and the expansive properties of air are taken full advantage of in this engine, just in the same way as the corresponding properties in the vapour of steam are utilised in the compound steam-engine—that is, in each case the gases are expanded from the smaller and high-pressure cylinders into the larger and low-pressure cylinders.

In appearance the engine necessarily differs from an ordinary locomotive, the absence of a funnel or other outlet for smoke or steam being the most prominent point of departure. The machine, which is noiseless, more or less resembles a large tank carried upon wheels, with sundry levers and handles on the top, where the driver is placed. The engine in question, however, is not of the form which is to be adopted in practice, but it is that in which the principle has been finally developed, and is now being demonstrated. The air is first compressed by a stationary engine and machinery into the reservoir of the air-engine. In the present instance the compression is effected by the machinery in the arsenal, by permission of the authorities, who have also consented to Colonel Beaumont carrying out his experiments there, seeing that the principle will find an important application in several directions connected with the Government, notably in that of electrically-steered torpedoes. The air is stored in the reservoir under a pressure of 1,000 lb. per square inch, and is delivered thence into the first and smallest cylinder at that pressure. After use there it is expanded into the second and third cylinders in succession, each cylinder having an increased cubical capacity in relation to the one preceding it. From the third cylinder, having there given out its last pound of useful effect, the air is ejected noiselessly into the atmosphere from a small port at the side of the cylinder. The first cylinder being of comparatively small area, difficulty might be experienced in starting the engine on a rising gradient or in the presence of other resistances. To meet this point there is an arrangement for admitting the air at full pressure into the second or intermediate cylinder, so that greater power is thus developed at the first stroke. Another difficulty invariably present when highly-compressed air is expanded is the extreme cold produced, which, as is well-known, is so great that the moisture in the atmosphere becomes condensed and frozen upon the working parts, thereby contributing to reduce the power and efficiency of the machine, and in time to stop its action. This difficulty is met in Colonel Beaumont's engine by the application of heat, externally, to the compressed air. This is effected by means of a diminutive steam generator, which is carried on the framing of the engine. So effectual is this application of a mild heat that the expanded air issues from the exhaust ports quite warm.

With this engine we lately made several runs with very satisfactory results, the machine working smoothly, noiselessly, and at good speed. A number of runs were effected over a straight length of that part of the Arsenal railway which runs direct from the proof butts to the Plumstead entrance of the Arsenal, the length traversed being nearly 700 yards. At starting the gauge showed a pressure of 1,000 lb. per square inch in the air reservoir, and at stopping this had become reduced to 620 lb., thus showing that only 180 lb. of pressure had been consumed in the runs, which in the aggregate amounted to a little over three miles. The engine weighs 10½ tons, and a truck containing several passengers which it hauled, weighed about 1½ ton more, making a total of 12 tons. The result of the runs, however, was not considered so good as had been obtained upon previous occasions, as a number of stops were made in order to test the controlling and other qualities of the engine. The engine is arranged so as to be able to make a run of 20 miles with one charge of compressed air. What it really has done, we are informed, has been to haul a gross load of 22 tons for a distance of 11 miles, and the lighter load of 12 tons for over 20 miles, with one charge of air, and which it did under the observation of the Arsenal authorities. From these experiments it was deduced that the engine will take three tons one mile with the expenditure of one cubic foot of compressed air. There can be no doubt that the engine, so far, has worked most satisfactorily, and there can be as little doubt that the new pattern engine, which we understand will soon be running on the Edinburgh and Portobello tramway, will prove as successful. If cost of production, maintenance, and working is found to be low, other things being equal there is a wide future before this system. Not only will it be applicable for tramway service, in which connection it has been mainly developed by Colonel Beaumont, but it will probably be found capable of working the traffic of our underground railways. This would be a great boon both to the railway passengers and to the company's servants. It will be seen that this system of applying compressed air differs from any that has been hitherto in use, inasmuch as it avoids the loss entailed by the use of a reducing valve and the cooling of the air by expansion. The arrangement appears to enable a much greater amount of power to be realised out of a given quantity of energy stored up than hitherto, and the success of the system, so far, entitles it to the consideration of those who are connected with our tramways and railways.—*The Times.*

VINTAGE OF FRANCE IN 1879.

The yield of wine in France during the year 1879 only amounted to 25,700,000 hectolitres, or 565,400,000 gallons, which is over 506,000,000 gallons less than that of 1878, and about 660,000,000 gallons less than the average of the last ten years. This result is due to various causes. The phylloxera and the oïdium have continued their ravages, and atmospheric perturbations have had further dis-

astrous effects. In some parts the continual humidity of the summer has prevented the grape from ripening; in other regions where the rainfall has not been great, the frosts in September and October dried up the seeds and preventing them from ripening.

The regions which have suffered most are Burgundy and Champagne, where there has been a total failure, or a relatively insignificant yield; the two Charentes, where the yield has hardly reached a third of the previous year; the departments of the centre of France, such as the Cher, Loire et Cher, Loiret, Indre, Indre et Loire, Vienne, Allier, and Nièvre, in which the production has fallen in the same proportion. In the eastern departments of the Doubs, Meuse, and Meurthe et Moselle, the crop represents hardly one-tenth of that obtained in 1878. The south has suffered less. The departments of the Aude, Herault, and Pyrénées Orientales even show an improvement on 1878 to the amount of about 2,000,000 hectolitres or 44,000,000 gallons.

The area planted with vines has diminished by 54,512 hectares, the hectare being equal to 2 a. 1r. 35,883 p., so that more than 150,000 hectares have been put out of cultivation since 1874.

Unfavourable as this state of things is, it is not without precedent. From 1853 to 1856, owing to the oïdium which had appeared for the first time, the wine crop had gone down to 22,000,000, 21,000,000, 15,000,000, and even 10,000,000 hectolitres. In 1859 and 1856 it only reached 29,000,000. In 1863 it began to increase, and it kept at an average of 50,000,000 to 60,000,000, attaining, in 1875, the previously unknown amount of 83,000,000. At the same time, during this prosperous period, there were years, such as 1867 and 1873, when the crop went down to 39,000,000 and 35,000,000, so that the conclusion is drawn that the deficiency in 1879 is due to a combination of disastrous circumstances which may be considered as exceptional. The amount of cider, too, which was made in 1879, was less by 4,197,000 hectares than in 1878.

CENSUS OF NEW ZEALAND.

The report of the Registrar-General of New Zealand on the result of the Census of 1878, has lately been published at Wellington. From this it appears that the sums spent in collection and compiling the last three Censuses were as follows:—

	Population.		Cost.
1871	256,393	..	£9,648 14 3
1874	299,514	..	8,740 10 1
1878	414,412	..	10,084 0 9

The expense under the old system in 1871, was a fraction over 9d. per head of the population, but in 1874 it was reduced to 7d. per head, and in 1878 to 5¾d. per head.

Population.

The population of the colony (exclusive of Maoris) on the 3rd day of March, 1878, numbered 414,412, an increase since March, 1874, of 114,898, or 38·36 per cent. The rate of increase was, therefore, much greater in the four years from March 1, 1874, to March 3, 1878, than in the previous period from February, 1871, to March, 1874, the increase during that period having only been at the rate of 16·82 per cent. Of this increase of 114,898, the natural increase by excess of births over deaths amounted to 40,844, or at the rate of 13·64 per cent. for the period. The balance, 74,054, consists of the excess of immigration over emigration during the same period. With a natural increase at the rate of 13·64 per cent. every four years, the population of the colony, if during the period there should be no excess of immigration over emigration, would, in 1886, amount to about 535,000.

The males in 1878 numbered 230,998, the females 183,414. The Chinese are included in these numbers, but exclusive of the Chinese the numbers would be 226,574 males to 183,405 females—an excess of males of 43,169. The increase of males since 1874 was 60,017, or 35·10 per cent. The increase of females was 54,881, or 42·70 per cent. There were on the 3rd March, 1878, 100 males to every 79·40 females. The disproportion between the sexes was less in 1878 than in 1874, in 1874 there having been 100 males to 75·17 females.

The inequality in the numbers of the sexes has been reduced in every district of the colony except Wellington.

Education.

In 1878, 62,866 children were returned as attending Government schools, 14,611 as attending private schools, 62,273 as attending Sunday-schools, and 9,706 as receiving tuition at home. While the numbers attending Government schools increased from 34,407 in 1874 to 62,866 in 1878, equivalent to an increase of 82·71 per cent.; the numbers attending private schools only increased from 13,752 to 14,611, an increase of 6·25 per cent. The establishing of the system of free education at the Government schools has compelled many persons to close their private schools, as they have painfully felt their inability to hold their ground in consequence of their having to charge for education.

Nationalities.

The number of British subjects in the colony was 395,607, or 95·52 per cent. of the population. The foreign subjects amounted to 18,569, or 4·48 per cent. of the population.

The persons born in New Zealand numbered 174,126, or 42·02 per cent. of the whole population; of these, 87,787, or 38 per cent., were males, and 86,339, or 47·07 per cent., were females. The number of New-Zealand-born in 1874 amounted to 122,635 persons. There has thus been an increase of 51,491 persons, or 41·99 per cent., on the New-Zealand-born population.

The Australian-born were 16,091 in 1878, an increase in four years of 2,490, or 18·31 per cent. The English-born increased from 74,628 in 1874 to 106,493 in 1878, or 42·70 per cent. The Scotch increased from 38,431 to 47,949, or 24·27 per cent.; the Irish increased from 30,255 to 34,758, or 44·63 per cent.; the Welsh increased from 1,381 to 1,702, or 23·24 per cent.; the Germans increased from 2,819 to 4,649; the Norwegians and Swedes from 1,780 to 2,375; the Danes from 1,172 to 2,225; and the Americans increased from 2,701 to to 3,165. The Chinese-born decreased from 4,828 to 4,442.

Religion.

Of a total population of 414,412 persons, 10,564 persons objected to state their religious belief. No entry was made in the column for religion in the household schedule opposite the names of 1,743 persons.

The Protestants of all denominations amounted to 334,745; the Catholics, including the Greek Church, to 58,945. Of the Protestant denominations, the members of the Church of England (including Protestants not otherwise defined) amounted to 176,337, or 42·55 per cent. of the population. The Presbyterians numbered 95,103, or 22·95 per cent. of the population; and the Methodists numbered 37,879, or 9·14 per cent. The Roman Catholics numbered 58,881, or 14·21 per cent. of the population. Of the principal denominations the Roman Catholics increased, since 1874, at the rate of 45·85 per cent.; the Methodist bodies collectively at the rate of 50·20 per cent.; the Presbyterians at the rate of 31·22 per cent.; and the Church of England at the rate of 38·66 per cent.

Of the smaller bodies, the Baptists increased from 6,355, or 2·12 per cent. of the population, to 9,159, or 2·21 per cent,; the Congregational Independents from

5,441, or 1·82 per cent., to 5,555, or 1·34 per cent. ; and the Lutherans from 3,914, or 1·31 per cent., to 5,643, or 1·36 per cent. Hebrews increased in number from 1,215 to 1,424, but the proportion to the total population decreased from 0·40 per cent. to 0·34 per cent. Pagans (embracing nearly all the Chinese) decreased from 4,764, or 1·59 per cent., to 4,379, or 1·05 per cent. The number of persons who objected to state their religious belief amounted to 10,564 against 6,760 in 1874. Of persons belonging to no denominations, Freethinkers numbered 490 against 135 in 1874, and Secularists 94 against 51 in 1874.

Illness.

Under the heading "Sickness and Infirmity" householders were instructed to enter the words "Sick or accident," as the case might be, opposite the name of any person who might at the time of the census be prevented from following his or her usual occupation by reason of illness. The census is thus the means of giving what could not be derived from any other source, viz., information as to the health of the whole adult population at a given time, accepting inability to work as a definition of illness. No notice has been taken of the sickness of persons under 15 years of age, as, with the instruction on the schedule above alluded to, any entries found could not be regarded as of value.

The total number of persons, of 15 years and over, returned as suffering from sickness, accident, debility, or infirmity, was 2,673, or 111·63 per 10,000 persons living. Distinguishing between the sexes, the proportion was greatest of males, mostly on account of their greater liability to accident, being 125·37 per 10,000 of males and 91·38 per 10,000 of females. Of these, the sick males amounted to 87·03 and the sick females to 80·63 per 10,000 respectively; the males suffering from accident to 31·19 and the females suffering from accident to 3·93 per 10,000.

Natives.

Although the Census Act, which provided for the enumeration of persons of European descent, does not apply to members of the native race, yet it was again considered desirable to obtain, if possible, an approximate estimate of their numbers. This has been done through the officers in native districts, who were desired to obtain information on the subject in a prescribed form, and report thereon. In some of the districts the numbers have been given with considerable accuracy, as the natives themselves have afforded facilities to the officers, and the names are entered in registers kept in the office; in other districts the numbers are given approximately, as, from the state of the native feeling with regard to Europeans, and the jealousy entertained of any attempt to obtain their exact numbers, an accurate enumeration cannot be made. The census, however, may be on the whole regarded as being more accurate than that taken in 1874, and probably as not differing materially from the actual numbers. In 1874 the total number of the Maori population was estimated at 45,470; in 1878 at 43,595. The numbers in 1874 are considered to have been slightly over-estimated in some districts, although, on the other hand, there are Maoris enumerated in 1878 who were not included in the number for 1874. The numbers as they stand represent a decrease of 1,875 since 1874.

MANGABEIRA RUBBER.

The largest quantity and the best quality of rubber has hitherto been imported from the province of Para, Brazil, and although it has long been known that other provinces of that vast empire contained forests of rubber-yielding trees, these have never been taken advantage of owing to the ignorance or supineness of the natives. The inhabitants of the province of Pernambuco are now beginning to realise the vast stores of undeveloped wealth existing in their virgin forests, and rubber is being exported from that province, which may soon rival Para in the extent of its exports of this article. This action is almost entirely due to the exertions of Senhor Joao Fernandez Lopes, who has spared neither time nor money in his endeavours to improve the agriculture of the province, and to develop its vast stores of natural wealth. This gentleman has issued a circular (dated April 26th, 1880) calling attention to this important source of wealth, and giving practical instructions for the collection and preparation of the rubber, from which the following is extracted:—

"Mangabeira rubber is the most suitable for the springs of railway waggons, tramway cars, and different machines, and for an infinity of other purposes. The process of extracting the milk from the Mangabeira tree is very simple and easy. Each person must be provided with fifty or more small tin basins and a small axe. He should make eight oblique cuts, sloping downwards, at a little distance from each other, all round the trunk of the mangabeira, cutting only the bark, and placing immediately below each cut one of the basins, securing these either with adhesive clay or nails. These small basins will collect the milk that exudes from the cuts, and, when full, they must be emptied into a larger vessel. This process should be continued during the whole day, and thus three or four bottles of milk may be collected, according to the fertility of the trees. The cuts should not be deep, as the milk is secreted just below the outside bark; and a great number of incisions should not be made on each tree, as these may weaken or kill the trees, which has been the case, in some instances, with the seringueira, the tree from which the Para rubber is obtained.

"The Para rubber is made in the place where the milk is collected, because, in the process of preparation by smoking, there is not time for the milk to be carried to the houses of the collectors; but here we do not prepare the rubber as they do in Para, but make use of the process introduced into the province of Para, in 1860, by Senor Strauss, which, being much simpler, gives admirable results.

"The process is as follows:—Put a little powdered alum into a teacup full of water, mixing it well, then put a few spoonsful of this solution into a vessel in which three bottles of the milk have been placed, properly strained, to clear it from any extraneous matter. Immediately the milk coagulates, which will be in two or three minutes, the rubber must be exposed to the air on sticks and allowed to drain for eight days. After thirty days, it is ready to send to market in cases or barrels. We have tens of leagues of mangabeira trees, and long ago we might have made use of this wealth, according to the opinion of Senhor Joaquino d'Almeida Pinto, an intelligent botanist of this province. The seringueira planted here grows perfectly, and there is no lack of different milk-giving trees that might be made useful. The province of Para exported last year three million kilogrammes of rubber, valued at six thousand coubos (£600,000.)

PYRENE OIL.

Consul Sebright, in a report on the trade of Corfu, refers to the manufacture of pyrene oil, which is obtained from the residuum of the pulp and kernels of olives, after the berries have been submitted to the usual insufficient amount of pressure, by which the oil is extracted in all the olive-producing countries bordering on the Mediterranean. The residuum in question retains from 2 to 4 per cent. of the oil, which for all time preceding the discovery and application of the present method of extracting was wholly lost to commerce. The experiment, at first hazarded on a limited

scale, has proved so successful, that there are now two manufactories of this product in active operation in the island of Zante; and to the single high-pressure cylinder employed here at the outset, another has since been added, worked by two steam-engines at 30-horse-power, and capable of producing, one year with another, from 700 to 750 tuns of oil. As in general a full olive crop is produced only in alternate years, the supply of the necessary material must vary accordingly; but a fairly regular supply is kept up by importation from the other islands, from Greece and Epirus, and even from Italy, where, with the exception of Lucca and Tuscany, the methods employed in the oil manufacture remain in a state of almost primitive inefficiency. The people of these countries cling with pertinacity to old habits, even in the teeth of their own immediate interests. In this spirit the peasantry of the island of Corfu persist in using the refuse of their olive mills for fuel, while one of the managers of the pyreme oil works states that he has neglected no opportunity of proving to them that for any given quantity of this substance they may obtain a price adequate to procure a quantity of firewood doubly sufficient for every domestic purpose. Attached to the pyrene oil works is a soap manufactory on a proportionate scale, worked by a steam-engine of 14-horse-power, and turning out from 30 to 40 tons of soap monthly, according to the demand. The article thus obtained is equal in its cleansing properties to the best sorts produced from the ordinary oil used in soap manufactories, differing only somewhat in the colour, which is of a palish green. An attempt was made two years ago to introduce it into the English market; but owing to the heavy freights, added to the export and import duties, the prices obtained were not sufficiently remunerative to encourage a renewal of the experiment.

COOKERY IN ELEMENTARY SCHOOLS.

Practice is as necessary in the art of cookery as in any other art, and although answers to questions relating to food and how to cook it are of use, they are subordinate in value to the power of natural cooking. The Government grant of 2s. per child is given at present for answers only, but it is anticipated that the time will come when practical proof of the art of cookery in schools will be required by inspectors. A letter appeared lately in the *Times*, which gives suggestions how cookery itself may be taught, and turned to practical account by feeding the children in small country schools. The writer of the letter, "R. D," states that "about four years ago, I took in charge about 2,200 acres in a remote county, where 14s. per week, including the value of perquisites and other incidental advantages, about represents the average weekly wages of an ordinary agricultural labourer. A census of the children between four and 13 was taken, and about 90 found, the bulk of them not knowing their letters. Schools were voluntarily built, and the payment per week, for five days of five hours in school each day, fixed at 5d. for one, 9d. for two, and 1s. for three of a family (more paying 3d. each), to include a midday meal; and, as an absolute rule in all cases, the money to be paid on Monday mornings in advance. At first the scale was complained of as high, but now all the parents are more than satisfied, and in ordinary weather we are seldom, from every cause, more than four or five short of our full numbers. Having paid their money, the mothers particularly are anxious to get full value, and as a consequence of having dined, not more than one in a month is absent from afternoon school, which, I need not add, is a matter of paramount importance to the teachers. As the result, we this year earned in Government grants within a trifle of the possible total, and the improvement in the appearance and general good health of the children is marked. We give eight weeks' holiday in the year—four at harvest, two at Christmas, one each at Easter and Whitsuntide. Between the 17th of March, 1879, and the 26th of March, 1880, the diners numbered 17,570, the cost of the material used 17,548 pence—about a dozen changes being rung out of the following 7,149 lb. 3 oz., viz.:—Flour, 2,472; potatoes, 899; bread, 743; rice, 509; meat, 476½; jam, 238; treacle, 229; sugar, 213; suet, 191; apples, 172; raisins, 155; cabbages, 144; onions, 143, milk, 130; currants, 118; carrots, 105; lentils, 98½; turnips, 76; peas, 48; sago, 35; beans, 20; lard, 19; salt, 12; pepper, 3; spice, 3 oz., or rather over 7 oz. per head before cooking, which is more than on an average is consumed, all having as much as they ask for. The object has been to provide such a wholesome, nutritious meal as, with good management, their parents' wages would allow at home. The nine senior girls, in rotations of three per week, help cook, wash up, and scrub and clean the refectory and schools generally, so getting their hands in for domestic service.—May 15." This account shows what can be done in the ten thousand schools throughout the country which are aided by the State. It were to be wished that the writer had stated by whom the actual teaching was given, and if by a trained teacher from the National Training School of Cookery, or by whom. It would seem that the teaching could hardly be given by the school teacher, already over-worked, and that special teachers of cookery must be created in sufficient numbers to make the work national.

ELECTRICITY AS A MOTIVE POWER.

The following letter, concerning certain experiments on the application of electricity as a motive power, appeared in a late number of the *Times*:—

"About this time last year I sent you a short account of some experiments by Mr. C. Felix, of Sermaize (Marne). This gentleman has continued his experiments, and at the Regional Agricultural Show, now being held in this town, his apparatus has been shown at work. It consists of the ordinary 'Gramme' machine, worked by a semi-portable engine, furnished by Boulet and Co., Faubourg Poissonnière, Paris. Two coils of wire convey the power to a smaller Gramme fixed on a framework of wood, movable on four wheels. This acts as an intermediate motion, and has two broad-face pulleys, one on each side, 20-inch and 14-inch diameter; these run at a speed, if required, of 800 a minute, the latter driving a six-horse-power thrashing machine at a considerable distance from the main power. The 20-inch pulley might be used for driving any other machine if required.

"The ploughing apparatus, which is at work at the same time in the field adjoining, consists of a similar Gramme machine, fixed in a very solid framework of wrought iron, about 9 ft. long by 5 ft. wide, standing on wheels, 3 ft. 6 in. diameter in front and 4 ft. 6 in. behind. Shafts and a locking gear are also attached. There are two of these at work for ploughing, as in Fowler's double tackle.

"The Gramme has two pulleys, as I before stated, one on each side. These, by friction rollers, work the drum of the ploughing tackle, round which the steel wire rope is coiled, the drum being in the centre of the carriage, the wire escaping from the lower part near the ground, and guided in its course by two flat rollers.

"The plough is one of Howard's double-furrow, supplied by Mr. Pilter, Paris, and fitted for the purpose.

"The power is conveyed in an instant from the main power in the showyard by a coil of wire on wooden reels, long enough to reach several fields off.

"The plough worked clean and regularly about seven or eight inches deep. The ground was very hard and uneven, as this part of France is suffering very much

from want of rain. One man is required to each machine, and one man to the plough, three in all. The ploughing was not very straight, for, as the people crowded about the plough and on the ropes, the driver could not see where he was going. Directly the plough reached the end of its course it was lowered and returned, the machine being thrown out of gear and reversed with the greatest ease.

"The machines are also advanced or retired without the least difficulty. When this is done, the friction rollers are detached, and the power conveyed to a chain and notched wheel, which move the machine rapidly forward as the ploughing work progresses.

"The manager, Mr. Ducret, states it would be just as easy to work a three or four furrow plough as this double, but the holdings being small in this country it is not necessary.

"Mr. Felix, who is here superintending his invention, has a large sugar factory at Sermaize, and there may be seen his various machines worked by electricity, as we, indeed, see in this showyard.

"The officials connected with the show and many others were present, and the greatest interest was manifested in the trials. Electricity as a motive power is only in its infancy, but who can help feeling sanguine as to its future?

"J. S. Cocksedge, of Stowmarket.

"Bar-le-Duc, France, May 22."

RESIN AND TURPENTINE.

The following account of the mode of production of resin and turpentine on the south-eastern coast of the United States is taken from an American paper:—"From Wilmington, N.C., southward, and nearly all the way to Florida, the pitch pine trees, with their blazed sides, attract the attention of the traveller. The lands for long stretches are almost worthless, and the only industry, beyond small patches for corn or cotton, is the 'boxing' of the pitch pine trees for the gum, as it is called, and the manufacture of turpentine and resin. There are several kinds of pine trees, including the white, spruce, yellow, Roumany, and pitch pine. The latter is the only valuable one for boxing, and differs a little from the yellow pine, with which it is sometimes confounded in the north. The owners of these pine lands generally lease the 'privilege' for the business, and receive about 125 dols. for a 'crop,' which consists of 10,000 'boxes.' The boxes are cavities cut into the tree near the ground in such a way as to hold about a quart, and from one to four boxes are cut in each tree, the number depending upon its size. One man can attend to and gather the crop of 10,000 boxes during the season, which lasts from March to September. About three quarts of pitch or gum is the average production of each box, but to secure this amount, the bark of the tree above the box must be hacked away a little every fortnight. Doing this so often, and for successive seasons, removes the bark as high as can be easily reached, while the quality of the gum constantly decreases, in that it yields less spirit, as the turpentine is called, and then the trees are abandoned. The gum is scraped out of the boxes with a sort of wooden spoon, and at the close of the season, after the pitch on the exposed surface of the tree has become hard, it is removed by scraping, and is only good for resin, as it produces no spirit. The gum sells for 1·50 dollars a barrel to the distillers. From 16 barrels of the crude gum, which is about the average capacity of the stills, 80 gallons of turpentine and 10 barrels of resin are made. The resin sells for from 1·40 dols. to 5 dols. per barrel, according to quality, and about pays for cost of gum and distilling, leaving the spirit, which sells for 40 cents a gallon, as the profit of the business. Immense quantities of resin await shipment at the stations along the line, and the pleasant odour enters the car windows as we are whirled along. After the trees are unfit for further boxing, and are not suitable for lumber, they are sometimes used to manufacture tar, but the business is not very profitable and is only done by large companies, who can thus use their surplus labour. The trees are cut up into wood which is piled in a hole in the ground and covered with earth, and then burned the same as charcoal is burned elsewhere. The heat sweats out the gum, which, uniting with the smoke, runs off through a spout provided for the purpose. A cord of wood will make two barrels of tar, which sells for 1·50 dols. per barrel, and costs 37½ cents to make. The charcoal is then sold for cooking purposes."

PARIS MUSEUM OF DECORATIVE ART.

The Musée des Arts Decoratifs, which arose out of the Universal Exhibition of 1878, and was at first established in the Pavillon de Flore, of the Tuileries, is now permanently lodged in a portion of the building of the Palais de l'Industrie, in the Champs Elysées. It occupies the south-east galleries, at the Place de la Concorde end, and is approached by door No. 7. The vestibule and the broad staircase, which leads to the gallery, are hung with carpets, some of which are very beautiful, and others curious.

At the head of the stairs is a collection of Arabian inlaid and other Oriental productions. Beyond is a wide gallery, which at once strikes the eye, on account of its simple and excellent arrangement. Here is a fine collection, including admirable specimens of furniture, bronzes, plate, Sèvres china, jewellery, glass, and other objects of art. Parallel with the gallery are rooms, containing a remarkable collection of *faïence* and porcelain, lent for a time only by the Musée Céramique of Limoges; and these, again, open into another gallery, in which is a fine collection of fans of all countries and periods, tissues of all kinds, art needlework, gloves, shoes, buttons, and a hundred other small wares, many of them unique. Some of our own manufacturers' choice productions, from the 1878 Exhibition, occupy highly honourable positions. There is one other room, devoted to designs and decorative drawings.

This museum has been set on foot by a national subscription, started by the Société Centrale des Beaux Arts, aided by the Ecole Nationale des Arts Décoratifs, and by a number of eminent artists, critics, and connoisseurs. A sum of upwards of a quarter of a million of francs was thus raised, and the Government has supplied the *locale*. Large donations have been made by the Ministèr des Beaux-Arts, and many eminent manufacturers and collectors.

NOTES ON BOOKS.

Nature's Hygiene: A series of Essays on popular Scientific Subjects, with special reference to the Chemistry and Hygiene of the Eucalyptus and the Pine. By C. T. Kingzett, F.C.S. London: Baillière, Tindall, and Cox. 1880.

The main object of this book is to point out the sanitary or anti-malarial properties of the eucalyptus and the pine, and with this view, the author treats of the discovery of oxygen, water, ozone, and peroxide of hydrogen and their occurrence in nature, of chemical oxidation, slow combustion and putrefaction, of infectants and contagious disorders, of antiseptics and and disinfectants. It has been calculated that in New South Wales and South Australia 96,897,440,00[illegible]

allons of oil may be held at one and the same time in
ie leaves of the eucalyptus trees massed together, and
ccupying a belt of country over which the hot winds
low. The author adds, "Now if this be so (and any
oubt there may be can only apply to the quantity) then
ie 96,897,440,000 gallons of eucalyptus oil can and
ust produce in the atmosphere surrounding the forests
o less than 92,785,023 tons of peroxide of hydrogen,
nd 507,587,945 tons of the camphoric substance
$_{10}H_{18}O_3$." Further on he remarks "It is probable
nat the hygienic influence of the pine is much greater
nan that of the eucalyptus, since it has a much wider
nd more extensive distribution in nature."

lements of Modern Chemistry.—By Adolphe Wurtz; translated and edited, with the sanction of the author, from the fourth French edition, by William H. Greene, M.D. London: W. Swan Sonnenschein, and Allen. 1880.

The author states that his endeavour has been to ondense a large number of facts without banishing the heory which binds them together, and to keep his work p with the current of the latest discoveries. Considering he history of the metalloids as the fundamental part of hemistry, he has treated this portion of the subject more argely than the other divisions. In respect to organic hemistry, Mons. Wurtz points out that the facts are o overwhelmingly numerous and complicated, that it is ecessary to make a severe and careful choice, and, in electing the points to be discussed, he has borne in nind the historical importance and the theoretical and ractical interest of the compounds described. With his object, he has treated the question of isomerism, 'upon which the theory of atomicity has thrown so nuch light," more thoroughly than in the former editions. He has also augmented the chapter on the aromatic compounds. The translator, who was formerly a pupil of Mons. Wurtz, has made a few additions to he book. The sources of certain minerals "not given n the French edition, have been introduced, and a few processes, to which greater attention is generally paid in English works, have been more fully developed."

OBITUARY.

Professor Ansted, F.R.S.—David Thomas Ansted was born in London on the 5th of February, 1814, and in 1832 entered at St. John's College, Cambridge. He graduated in mathematical honours in 1836, as thirty-second wrangler, and took his M.A. degree in 1839. He studied geology under Professor Sedgwick, and at the early age of twenty-six was appointed to the chair of that science in King's College, London, in succession to Professor John Phillips. A few years later he became Lecturer on Geology at the East India College, Addiscombe, and Professor of Geology at the College of Civil Engineers, Putney. He was elected a Fellow of the Royal Society in 1844, and in the same year he took the office of Assistant-Secretary to the Geological Society. He acted as juror and reporter at the Great Exhibition of 1851, when he joined the Society of Arts, and since that period he was actively connected with the work of the Society as a member of committees, and otherwise. In 1865, he delivered a course of Cantor Lectures, on the "Applications of Geology to the Arts and Manufactures," and in 1877, he read a paper "On the Treatment of Town Refuse and Sewage, as recently introduced at Manchester, and previousiy tried at Salford." He contributed one of the essays on the suggested division of England and Wales into districts for the supply of pure water, and a paper on "River Conservancy," to last year's Conference on National Water Supply, &c. In addition to these, he was a frequent contributor to the Society's *Journal*. Besides his well-known scientific manuals, he was the author of several popular works of travel. Of late years, Professor Ansted's time had been chiefly devoted to his duties as a consulting mining engineer, and he died, after a short illness, on the 13th May, in the midst of his work.

GENERAL NOTES.

Indian Tea.—The yield of this year's harvest of tea in India is estimated at 70,000,000 lbs., or nearly double that of 1878, which was 37,000,000 lbs. Only ten years back scarcely more than 13,000,000 lbs. were produced in the year.

Potato Flour.—Attention is drawn in the *Monthly Magazine of Pharmacy* to the large consumption of potato flour, which is simply the dry evaporated pulp of the common potato. It is used for sizing and other manufacturing purposes; and by precipitation, and with the aid of acid, is turned into starch. When calcined it is used largely for silk dressing as well as for other purposes. In Lancashire alone 20,000 tons are sold annually, and at present the quotation for potato flour in Liverpool is nearly double that of wheat flour.

Munich Art Exhibition of 1879.—The Committee of the International Exhibition of Arts held at Munich in 1879 has prepared a pamphlet from official documents, programmes, and reports of meetings, which gives a sketch of the origin and mode of carrying out this undertaking. A copy of this has been presented to the Society of Arts by the Lords of the Committee of Council of Education, to whom it has been transmitted through the Secretary of State for Foreign Affairs.

Africa.—The International African Association of Brussels have published the third number of their transactions, which contains reports of the movements of the travellers sent out by the association at Karéma, Tabora, and Mpwapwa, and an essay by Dr. Dutrieux, on the diseases and acclimatisation of Europeans in East Central Africa. The chief points treated of in the latter are the African fever, dysentery, and the necessary conditions for a successful acclimatisation.

Artists' Colours.—It is announced that the meeting for the purpose of discussing the various points raised by Mr. Holman Hunt in his paper, "The Present System of Obtaining Materials in Use by Artist Painters as Compared with that of the Old Masters," which was read before the Society of Arts on Wednesday, April 21st, is fixed for Tuesday, June 8th. The meeting will be held at the Grosvenor Exhibition Gallery, Bond-street, at 7.30 p.m., so that the specimens may be inspected before the chair is taken by Sir Coutts Lindsay, at eight o'clock. Application for tickets should be made to the Secretary of the Grosvenor Library. A new Society, called "The Painters' Guild," has been formed for the purpose of making experiments on painters' materials.

Exhibition of the Applied Arts in Paris.—The exhibition announced by the Société Centrale des Beaux-Arts Appliqués is now definitely announced to open on the last day of July in the Palais de l'Industrie. This is the sixth exhibition organised by the Société Centrale in the same place, and each of the preceding has been successful, not only on account of the excellence of the contributions, but also from the good arrangements and organisation. Former exhibitions of the society had each a special character of its own, but included several features. The coming one is the first of a series of technological exhibitions of art industries, classified according to the nature of the raw material employed. It will be devoted to the industries in metal, and in following exhibitions tissues, paper, skin and leather, wood, stone, glass, &c., will be illustrated in the same manner. On each occasion the exhibition will include a retrospective section.

Floor Coverings.—Messrs. Treloar and Sons have lately published a pamphlet, entitled "Mats and Floor Coverings," which consists of eight chapters, on the different varieties that have been or are now in use. Tapestry, carpets, and rugs, as made in different countries, and oil cloth, linoleum, kamptulicon, corticene, and other species of floor

cloths are all described. It is stated that in 1866 the estimated value of the carpet manufacture of Great Britain was £2,110,000, including goods of the value of £1,217,682 exported, the quantity being 7,600,511 yards, and that 50,000 workpeople are engaged in the carpet manufacture of the United Kingdom.

Colour Blindness.—The Legislature of the State of Connecticut has passed an Act authorising the State Board of Health to prepare rules and regulations for the examination and re-examination of railroad *employés* in respect to colour blindness and visual power, and prescribing the method in which, and the intervals at which, such examinations shall be made. The Act further makes provision for inflicting penalties on any railway company employing persons who are not in possession of a certificate from the examining Board of their freedom from colour blindness. The examiners may revoke the certificate at any time. The State Board is, in the month of May, to recommend two or more medical experts to make the necessary examinations, and the Governor is to appoint two of these gentlemen on the following first of July.

THE LIBRARY.

The following works have been presented to the Library:—

Report on Cotton Gins, and on the Cleaning and Quality of Indian Cotton, by Dr. Forbes Watson. Two Parts. (London: William H. Allen and Co., 1879.) Presented by the Secretary of State for India in Council.

Catalogue de la Collection Possenti de Fabriano. Objets d'Art et de Curiosité. (Rome, 1880.)

Life of John Evelyn, Esq., F.R.S., by Henry B. Wheatley, F.S.A. (Extract from Vol. I. of the Diary.) (London: Bickers and Son, 1879.) Presented by the Author.

Sculptors of the Day: a list of the Profession in 1880. Edited by William Hooe. (London: William Poole. 1880.)

French: Practice and Theory, by G. C. Mast. (London: Joseph Boulton and Co., 1880.) Presented by the Author.

Eyesight: Good and Bad. A Treatise on the Exercise and Preservation of Vision, by Robert Brudenell Carter, F.R.C.S. (London: Macmillan and Co., 1880.) Presented by the Author.

Nature's Hygiene: a Series of Essays on Popular Scientific Subjects, by C. T. Kingzett, F.C.S. (London: Bailliere, Tindall, and Cox., 1880.) Presented by the Author.

Aesthetics of Musical Art, by Dr. Ferdinand Hand. Translated from the German by Walter E. Lawson, Mus.Bac.Cantab. Book the First. (London: William Reeves, 1880.) Presented by the Publisher.

Photography: its Origin, Progress, and Practice, by J. Werge. (London: Simpkin, Marshall, and Co.) Presented by the Author.

Reply to the Report of the Committee of the House of Commons on Indian Public Works, by Sir Arthur Cotton, R.E. (Dorking). Presented by the Author.

Report of the Lighter Navigation of the River Neva and Gulf of Finland, by Henry W. Hammond. (London, 1879.) Presented by the Author.

Catalogue of Books and Papers Relating to Electricity, Magnetism, the Electric Telegraph, &c, including the Ronalds Library. Compiled by Sir Francis Ronalds, F.R.S. Edited by Alfred J. Frost. (London: C. and F. N. Spon, 1880.) Presented by the Society of Telegraph Engineers.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 7th...Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Arthur Rigg, "Sensitiveness and Isochronism in Governors."
British Architects, 9, Conduit-street, W., 8 p.m. A Communication from Lysandros Kaftangioglou (Athens), relative to a discovery during the recent Excavations made in and around the Chæroneian Lion, will be read by Prof. Donaldson. Exhibition of some of the Architect's drawings of Truro Cathedral, &c.

Tuesday, June 8th...Metropolitan Scientific Association, 13, Blomfield-street, E.C. (at the House of the Society of Arts), 7 p.m.
Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Anniversary. Address by the Right Rev. Bishop Cotterill, D.D.
British Association of Gas Managers, 25, Great George-street, E.C., 10 a.m. Annual Meeting. Inaugural Address by the Acting President; Admission of New Members; Reading of Papers and Communications. Evening Meeting, 7.30. Lecture by Mr. Greville Williams, "The Past, Present, and Future of Coal Tar."
Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Photographic, 5A, Pall-mall East, S.W., 8 p.m. 1. Capt. Abney, "Aids in the Working of the Gelatine Bromide Process." 2. Mr. T. Bolas, "The Reproduction of Negatives, in a Reversed Direction, by the Inverse Action of Light on Gelatine Plates."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. F. G. Hilton Price, "Camps on the Malvern Hills." 2. Rev. R. H. Codrington, "Religious Beliefs and Practices in Melanesia." 3. Mr. Peter Bembridge, "The Aborigines of Victoria."
Royal Colonial, St. James's-hall, Regent-street, W., 8 p.m. Mr. Arthur F. Halcombe, "New Zealand."
Royal Horticultural, South Kensington, S.W., 1 p.m.

Wednesday, June 9th...British Association of Gas Managers, 25, Great George-street, S.W., 10 a.m. Annual Meeting. Reading of papers, and discussions continued.
Geological, Burlington-house, W., 8 p.m. 1. Mr. J. E. Marr, "The Pre-Devonian Rocks of Bohemia." 2. Dr. J. Gwyn Jeffreys, "The Occurrence of Marine Shells at Different Heights above the Present Level of the Sea." 3. Mr. Henry Hicks, "The Pre-Cambrian Rocks of the North-Western and Central Highlands of Scotland." 4. Mr. James Buckman, "The Terminations of some Ammonites from the Inferior Oolite of Dorset and Somerset." 5. Mr. Arthur H. Stokes, "Faröe Islands. Notes upon the Coal found at Suderöe." 6. Mr. P. Herbert Carpenter, "Some new Cretaceous *Comatulæ*."
Microscopical, King's College, W.C., 8 p.m. 1. Professor H. Smith, "The Life History of the Diatomaceæ." 2. Mr. S. Holmes, "A New Binocular Microscope, with Isophotal Prism." 3. Mr. W. H. Gilburt, "The Structure and Functions of the Scale-leaves of *Lathræa squamaria*." 4. Mr. J. W. Stephenson, "The Relative Visibility of Minute Structures when mounted in Phosphorus, Bisulphide of Carbon, or other Media."
Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Thursday, June 10th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 11 a.m. Annual Conference on the Progress of Public Health.
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
British Association of Gas Managers, 25, Great George-street, S.W. Annual Meeting. Excursion by Steamboats to Beckton to inspect the Works of the Chartered Gas Company.

Friday, June 11th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 11 a.m. Annual Conference on the Progress of Public Health.
Royal United Service Institution, Whitehall-yard, 3 p.m. Discussion on the subject of the Naval Prize Essay, viz.:—"Naval Tactics on the Open Sea, with the Existing Types of Vessels and Weapons."
Astronomical, Burlington-house, W., 8 p.m.
Geologists' Association, University College, W.C. Excursion to Kew, under the direction of Sir Joseph D. Hooker.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "The Physiology or Functions of Plants." (Lecture VI.) "On the Organs of Reproduction."
New Shakspere, University College, W.C., 8 p.m. 1. Rev. H. N. Ellacombe, "The Seasons of Shakspere's Plays." 2. Mr. F. J. Furnivall, "The Utter Failure of Mr. Swinburne's Metrical Argument against Fletcher's Share in 'Henry VIII.'" 3. Rev. J. Kirkman, "Suicide in Shakspere."

Saturday, June 12th...Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Dr. R. C. Shettle, "The Earth's Rotation as Influenced by Solar Energy." 2. Mr. R. H. Ridout, "Note. on a Simple Method of Amplifying Small Motions."
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, JUNE 11, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council of the Society of Arts have awarded the Albert Medal of the Society of the present year to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science and industrial pursuits."

NATIONAL TRAINING SCHOOL FOR MUSIC.—CONCERT BY SOCIETY OF ARTS SCHOLARS.

Arrangements have been made for a concert by the Society of Arts scholars at the National Training School for Music, assisted by some of the other scholars, to be given in the Great Room of the Society, on the afternoon of Tuesday, the 22nd inst. Admission will be by tickets only, to be obtained by members on application, and no person, whether a Member or not, can be admitted without a ticket. A sufficient number of tickets to fill the room will be issued to Members in the order in which they apply, and the list will then be closed. Each ticket will be numbered; it will admit one person, and will be transferable. Two tickets will be issued to each Member applying for them. Members requiring tickets should apply at once to the Secretary, stating whether a single ticket or two tickets are desired.

Should a sufficient number of applications be received, to render it desirable, the concert will be repeated on the afternoon of Thursday, the 24th inst.

By order,
H. TRUEMAN WOOD, Secretary.

CONVERSAZIONE.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday, the 16th of June. The cards of invitation have been issued to Members.

CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The Annual Conference on the Progress of Public Health was opened in the Rooms of the Society of Arts yesterday, at eleven o'clock, and the chair was taken by the Right Hon. James Stansfeld, M.P., and during his temporary absence, by Lord Alfred Churchill, Chairman of Council.

The following resolution (proposed by Mr. STANSFELD, and seconded by Professor WAY), was passed at the meeting:—

"This Conference confirms the resolution passed by the Conference of 1878 in favour of the constitution of County Boards to conduct the ordinary administrative and financial business of the county.

"This Conference is further of opinion that such representative County Boards should be instituted with the least possible delay, and that the functions entrusted to them, and the powers conferred upon them, should be wide and full, and conceived in the view of enlarging, elevating, and re-invigorating the principle of local self-government in this country; and, further, it is the opinion of this Conference that such County Boards or combinations of them, in preference to newly constituted authorities, should be charged with the conservancy of rivers, including the prevention of floods, the storage of water, and the preservation of rivers from pollution. And lastly, that such County Boards should also be charged with the appointment of County Health Superintendents in each county."

At the conclusion of the sitting, Mr. Robert Rawlinson, C.B., by the kind permission of Earl Spencer, K.G., conducted a party over Spencer-house, and explained the new sanitary arrangements adopted there.

A full report of the proceedings of the Conference will appear in the *Journal*.

SANITARY SECTION.

A public meeting will be held on Monday, 14th June, at 12 noon, in the Room of the Society, to discuss the evidence on House Drainage in London, given before the Committee of the Sanitary Section of the Society, by Messrs. W. Eassie, Rogers Field, and E. F. Griffith. Members of the Society, and others interested in the subject, are invited to attend.

SANITARY EXHIBITION.

The Exhibition of Sanitary Appliances will continue open until Monday, the 14th inst. The public will be admitted on presentation of a visiting card.

BRITISH AND UPPER BURMA, AND WESTERN CHINA: THEIR CONCURRENT COMMERCIAL INTERESTS.

By Colonel W. F. B. Laurie.

Politically speaking, British and Upper Burma should be one, to make matters entirely safe in Eastern Asia. Commercially speaking, the unity of these two countries, in the vast interests of a comparatively new and rapidly rising commerce, as well as of civilisation, cannot be too much insisted on. It is simply a natural state of things—a sort of holy alliance designed by a far greater than Indra, and brought about chiefly by the mighty Irawadi—the grand artery or highway of Burma—which it were idle not to recognize. Ireland is not more necessary to the power and prosperity of England than Upper Burma is to Pegu.

Alompra, the hunter—founder of the present dynasty—knew well the value of what I have styled elsewhere a "Princess among the Provinces;" and it did not require any very great genius to know that a kingdom, such as Upper Burma, entirely cut off from all communication with the sea, or from the advantages of many fine ports, was sheer mockery—a crown of tinsel, as Lord Dalhousie remarked; and this was the cause of the late King of Burma's persistently, yet naturally, refusing to sign away in the treaty of 1855, Pegu, the glorious conquest and inheritance of his ancestor, notwithstanding the well arranged existence of "friendly relations" between us*. Without any desire to advocate annexation, I believe there is a deeply-felt yearning for British rule or British protection throughout Upper Burma; for the people of the lower country are a thousand times safer and happier than ever before, as would be immediately seen by treading "the long extent of backward time" in the histories of Pegu and the former kingdom of Ava.

For the sake of those who have not been able to give much time or attention to Burma, before turning to commercial matter, I shall beg leave to state very briefly that Pegu, Arakan, and the long line of sea coast, named Tenasserim—the three maritime provinces of Chin-India or India beyond the Ganges—were united under one administration in January, 1862, and called British Burma. Arakan and Tenasserim were acquired by treaty after the first Burmese war of 1824-25-26; and Pegu was occupied and retained consequent on the second war of 1852-53. The entire length of the country is upwards of 900 miles, and the area about 90,000 square miles, or half the size of Spain. The country lies between 20° 50′ on the north, and on the south in about 10° 50′ north latitude. British Burma is bounded on the West by the Bay of Bengal; Arakan, on the north by Chittagong, and some independent States, and on the east, by the Yoma Mountains; Pegu is separated from Upper Burma on the north by a line, corresponding to the 19° 30′ parallel of north latitude, and is bounded on the east by the Salween River; Tenasserim is bounded on the east by a long line of mountains, separating it from Siam, and varying from 3,000 to 5,000 feet above the sea. The physical aspect of the country is thus described:—Arakan is separated from Pegu and Upper Burma on the east by a range of mountains, which attains, at its greatest elevation, a height of 7,000 feet. The range runs nearly parallel with the line of sea coast, and gradually lowers towards the south. The northern portion of the country has a large extent of alluvial soil. In the lower course of the River Kuladan (which rises in the mountains to the east of Arakan), and its numerous affluents, the breadth of the land, from the shore to the water-shed mountains, is from 80 to 90 miles. The water-shed range, separating Arakan from Pegu, extends southerly, and between that range and the sea-shore for a length of nearly 200 miles, as far as a point near Cape Negrais, the country is a mere narrow strip of land. Pegu and Martaban lie in the valleys of the Irawadi and Sittang rivers. These valleys, bounded east and west by mountain ranges, are narrow in their upper portions, but expand at the delta of the Irawadi into "a magnificent alluvial region, penetrated by a vast number of tidal creeks, and extending over 10,000 square miles."

Rangoon is described as a district in the Pegu division occupying the sea-board from the mouth of the Tsit-Toung westward to that mouth of the great Irawadi river which is generally known as the China Bakir, but is more correctly called the To, and extending inland up the valleys of the Irawadi and Tsit-Toung rivers to the Henzada and Tharawadi districts on the west of the Pegu Roma, and to the Shwé-gyeen district of Tenasserim on the east. Rangoon, as has already been said, the capital of the Pegu Province and, consequently, of British Burma, is some 20 or 25 miles from the sea. The future Liverpool or Glasgow of Chin-India, before a word is said about its commerce, may be considered worthy of brief mention as to the origin of the name. In the early Talaing histories it has the name of Dagon, originally that of the Shwé Dagon pagoda. Eventually, we read, in the wars which took place between the kings of Pegu and of Burma, Dagon often changed hands, and when at last, in 1763, "the Burman Aloung-bhoora (Alompra) drove out the Talaing garrison of Ava, then the Burman capital, and eventually conquered the Talaing kingdom, he came down to Dagon, repaired, and thus, to a certain extent, to Peguan feelings, desecrated the great Shwé-Dagon pagoda, almost refounded the town, and re-named it Ran-Koon (the end of the war, from "ran" war, and "koon" or "goon" finished, exhausted) or Rangoon, the name it has ever since borne, and made it the seat of the viceroyalty which he established." In the last decade of the 18th century, the English obtained leave to establish a factory in Rangoon, surrounding it by a brick wall, and hoisting the British colours. From this point we may pass on to the Irawady (Irawadi), the grand artery of Burma, and the constant feeder of Rangoon, with the commerce and wealth of the upper country, south-west China, and the various States around, and to the northward of Mandalay, the Burman capital, now so well known to the British merchants of Rangoon, and made famous by deeds of dreadful note.

With such a magnificent highway as the Irawadi, with its many mouths, aided by the other main rivers, the Hleing or Rangoon, the Pegu, the Sittang, and the Beling, it may be said that there is no limit to the progress of commerce in Burma. The Irawadi flows for about 800 miles before reaching the British possessions, through which it runs for 240 miles more. It is navigable for river steamers as far as Bhamo, 600 miles beyond the British frontier. The velocity of its waters, when the river is full, is said to be five miles an hour. General Fytche informs us that "Colonel Yule, from facts collected by him, assumes that the Irawadi takes its rise in the lofty Langtam range of the Himalayas, whose peaks, covered with perpetual snow, separate the valleys inhabited by the Shan race of Khamtis from the head waters of the sacred Brahmaputra." But the sources of this principal river in Upper and British Burma, which traverses the Pegu division from north to south, have never been explored, though several praiseworthy attempts have been made. The most recent information I have seen on the subject is, with reference to the attempt made in 1827 by Lieutenants Wilcox and Burlton, and more recent explorers, that it has been shown "as conclusively as can be shown, until the river is traced to its source, that it rises in the southern slopes of the Patkoi mountains, one branch in 28° N. lat., and 97° 30′ E. long., and another in the same mountains, a few days journey further eastward. The two, that to the west, called by the Burmese Myit-

* "Our Burmese Wars and Relations with Burma," pp. 379-80. —London: Wm. H. Allen and Co.

gyee, or large river, and that to the east, Myit-nge, or small river, uniting to form the Irawadi, in about 26° N. lat." It is interesting to note, with reference to Henzada, a large district in the Pegu division, covering an area of upwards of 4,000 square miles "in the valley of the Irawadi, at the head of the Delta, and lying on both banks of that river," that nearly all the large towns are on the right bank of the Irawadi, though many important places are in Tharawadi, that is the country east of the river; here, however, the great extent of the annual inundations, and the smaller extent of country fitted for the cultivation of rice, the great staple produce of the province, though, perhaps, favourable to the existence of numerous small villages, retard the formation of the large trading towns, and nearly all large towns in this district owe their magnitude, if not their very existence, to trade in the products of the surrounding country. Again, the larger number of the Henzada villages and hamlets are along the banks of the Irawadi and on the banks of the tributary streams to the west of that river. It may safely be asserted that the embankments along the Irawadi, which protect such an extensive tract of fertile rice country from the inundations to which it was annually subject, will not only produce a steady increase in the size of villages now existing and occupied by cultivators of the neighbouring plains, but will cause the establishment of many new ones in spots hitherto waste and waiting only for relief from the superabundant waters of the river, and for labour to become valuable and fruitful fields. The breadth of the Irawadi varies from one to two, three, and even four or five miles, and of this noble river which intersects the Burman dominions, it has been well said, "like the Nile and the Ganges inundating the plains, it dispenses fertility and abundance, while it affords an extensive inland navigation quite through the country to the borders of China."

Let us now return to Rangoon, the grand emporium of commerce in British Burma, where "the quick pulse of gain" is ever on the alert, and where fortunes have been made and lost—and, doubtless, are still—with amazing rapidity. Rice being the grand export of the Pegu province, it may first be of interest to note the remarkable increase of rice land under cultivation from 1868 to 1876, in spite of occasional excessive inundations (very frequent before the increase of embankments in 1862) in the Henzada district, the township of which is on the right bank of the Irawadi. In 1868 the cultivated area was 204,495 acres, and in 1876, 320,300 acres; or, since the annexation of Pegu (1853), there has been an increase in the total cultivated area of nearly 250,000 acres, "greater than the most sanguine could have hoped for." It may also be remarked that the cotton grown in this (Henzada) district is inferior to that grown in the north, the produce being locally consumed; but rice, as already stated, is the chief commodity of the Henzada district, which, situated at the head of the delta of the Irawadi, and containing much fertile land for the cultivation of this most useful grain, affords a ready market for Rangoon and Bassein, communication with both being easy from the numerous creeks which intersect the country. In a country like Pegu, where there is a great sparseness of population, but which has risen from a little more than a million in a quarter of a century to about three millions, it may be noted that out of the total 176,404 males in the Rangoon district, in 1872, the paucity of the Talaings being especially noticable, there were nearly 4,000 Christians, 600 Hindus, 300 Mahomedans, and nearly 171,500 Buddhists. In 1878, the capital had 91,500 inhabitants. The population of the town of Rangoon for variety is perhaps unsurpassed in the world: Burmans, Talaings, the Mon race, Karens, Shans, Aracanese, Hindus, Mahomedans, Chinese, Europeans, Eurasians, Americans, and others; in the census year of 1872, giving a total of 98,700. The population is now (1880) over a hundred thousand (100,000) for like the river traffic between Mandalay and Rangoon, since 1862, it may be said to have gone on steadily increasing till 1878-79. The principal articles manufactured in the Rangoon district are salt, pottery, fish paste (nga-pee) mats, and silk and cotton cloths, all for local consumption, except the pottery and nga-pee, which are exported, the latter to Upper Burma. The salt is made during the hot weather along the sea coast, and elsewhere, by solar evaporation, or by "boiling in iron or earthen pots, the iron yielding the greater out-turn."

It is interesting to look back on the state of commerce with the British settlements in India from 1802 to 1806. Then the exportation of rice and of the precious metals was strictly prohibited, and the total imports exceeded the total exports by 1,856,638 Rs. The imported articles in the year (1805) of Trafalgar, were tin, wine, woollens, piece goods, opium, grain, rum, tin and plated ware, ironmongery, canvas, &c., giving a total value including treasure (19,579 Rs.) of 245,232 Rs. The articles of export were timber, pepper, orpiment, coir rope, ponies, cardamans, stick-lac, wax, sundries, and treasure. From 1813-14 to 1820-21 the returns of trade between Rangoon and Calcutta give the principal imports, as piece goods, raw silk, cotton, indigo, saltpetre, sugar, rice, pepper, and opium. At the close of the first war (1826), Arakan became a rice granary of immense importance, in a great measure obviating the import of rice from Calcutta. After the second Burmese war (1852-53), Pegu became British territory. From 1826 to 1852, among the annual number of arrivals and departures there were only 20 English vessels, from 100 to 1,000 tons. In 1855, the total tonnage of all vessels, import and export, amounted to upwards of 270,000 tons, which, in nine years (1863-64), became doubled, and has been increasing in an astonishing proportion ever since. No wonder it has been said that "when Pegu passed to the English, trade began to improve, and has proceeded with vast strides." When we come to consider that the value of the export and import trade, excluding treasure, in 1877-78 amounted to 81,920,257 Rs., as compared with 21,310,561 Rs. in 1858-59, we must unhesitatingly declare that such a steady prosperity as this is unparalleled in the history of British connection with the East.

These facts alone are well worthy of attention from the lords of British commerce, and show what might be done were there no monopolising obstructiveness of a Burmese golden-footed monarch to be encountered.

If free trade, wandering up and down the world, should ever seek a fitting temple to dwell in, perhaps, with her mutual friend reciprocity, attended by the honoured shade of Richard Cobden—all regal obstructives being swept away—she will not be able to do better, while waiting for the golden edifice, than pitch her tent in Chin-India. Upper Burma would afford her triumphs which she could not gain elsewhere, and certainly in no other portion of our Eastern Empire.

The commerce of British Burma is carried on chiefly with Great Britain, the three Presidencies of India, the Straits, Ceylon, and the Nicobars. The ports are Rangoon, Maulmain, Akyab, Tavoy, Mergui, Bassein, Kyook Phyoo, and Cheduba—certainly no want of fine harbours for trade. Before the Burmese wars, the articles of import and export have already been mentioned. The former, after the second war, consisted chiefly of cotton goods, hardware, machinery, coal, books, provisions, woollen goods, silks, canvas, wines, drugs, dyes, spices, fruits, sugar, arms, and carriages. The exports have principally been rice, timber, petroleum, hides, ivory, cotton, grain, and ponies. To this may be added jewellery and precious stones, also a goodly list of useful sundries. In trade with Burma, as a rule, the imports have generally exceeded the exports, although such was very far from being the case in 1877-78, and

in a few other years. In a year of famine in India or elsewhere, the exports from Rangoon would probably exceed the imports. General Fytche, in his "Burma Past and Present" remarks, after the astonishing but truthful statement, that "if the commerce of India bore the same proportion to population" (as British Burma), "it would be ten times greater than it is;" "that is to say, it would be nine hundred and fifty millions instead of ninety-five;" that "British Burma also contrasts favourably with India, in the value of the imports being much nearer to that of the exports." I now proceed to remark that some fifteen years ago, the annual value of the imports were rather more than £2,000,000, and of the exports than three. In 1875-76 the value of the sea-borne and inland exports was £7,208,896, and imports £6,159,925, with a population a little over three millions, and a gross revenue over two millions sterling.

On Pegu passing to the English, the whole Burmese customs system changed, and restrictions on importation and exportation were removed, and the interior of the country gradually developed. Rangoon soon became the third port in India. "Cotton, piece goods, salt, and various other articles have poured in, whilst rice has more than taken the place of timber and cutch, hides and horns, and petroleum, have added to the export trade." It may also be remarked, with reference to the various imports and exports, that some of the articles merely pass through the country; candles, cotton-twist, cotton piece goods, earthenware and porcelain, glass, glassware, &c., find their way direct into Upper Burma, whilst caoutchouc, raw cotton, gums and resins, hides, horns, ivory, lac, mineral oils, spices, tobacco, and wood, are partly, and jade is entirely, drawn from that country. The duty levied, of course, depends upon the tariff.

A great season in Rangoon—perhaps, the greatest—is the rice season, which commences in January and ends in May; but there are sales all the year round. The prices of rice in the husk at the mills in Rangoon during seven years varied, per 100 baskets, in rupees, from 1872 to 1878, from January to October, from 55 to 100 and 200 rupees; and it may be stated that each firm of rice producers has its one or more brokers and several buyers, the former, as a rule, residing on the mill premises. In its strictest sense, *nunquam dormio* may be considered a most appropriate motto for Rangoon, destined, as I have already remarked, to be the Liverpool or Glasgow of Chin-India.

I shall now make a few remarks on the trade, *in esse*, with South-Western China, which I shall preface by a few words on the treaties we concluded with Upper Burma, in 1862-67. By the treaty of 1862, concluded by Sir Arthur (then Colonel) Phayre, trade in and through Upper Burma was "freely thrown open to British enterprise," and, again, the Bhamo trade route (to Yunnan, in South-West China) was to be explored "under the treaty of 1862." The King of Burma would not consent to a "joint mission," as desired by the Indian Government. Perhaps the vassal, Golden Foot, although "Lord of the Earth and Air," thought he might offend his Chinese Lord the "Vicegerent of all under Heaven," by so doing; but if any man could have obtained the wishes of our Government at this time, beyond all question, that man was the first Chief Commissioner of British Burma. And this leads me to remark that I committed an error or rather inadvertence in my review of Dr. Anderson's interesting work, "From Mandalay to Momien," where I say that "there was evidently something wrong in the framing of the treaty of 1862." I should have written that there was evidently considerable difficulty about the "joint mission," as regarding trade with South-Western China, through Upper Burma, in the endeavour to bring the treaty of 1862 to the successful issue desired by the Indian Government.

As has been remarked, then, the treaty of 1862 paved the way for the well-known mission or expedition under Major Sladen, at the commencement of 1868, to explore the trade route to China, *viâ* Bhamo (consequent on the treaty under General Fytche, of 1867), which, notwithstanding the credit attached to the officers concerned, led to no useful or practical results. "Possibly," it has been said, "King Mengdon was not displeased at our want of success; but, strange enough, provoking, and frequently petty obstructions have, in some way or other, surrounded British exertions, with regard to commerce in Upper Burma, ever since 1868; and when Mengdon died, towards the end of 1878, his eccentric son Theebau's dissipated and murderous career began, as if to make the chance of sound friendly relations with the British, in the interests of commerce and civilisation, more distant than ever. And, in my humble opinion, after the withdrawal of our resident from Mandalay, to make a treaty—commercial or otherwise—with such a modern Nero, would be highly impolitic, and the very worst thing we could do. Lord Dalhousie, in reviewing his administration, in the famous minute of 28th February, 1856, writes:—"When the Honourable Court recalls to mind that, from the very first in 1852, I deprecated the reconstruction of any treaty relations with the Court of Ava at all, it will not be surprised to find me add that I still consider peace with Ava as even more likely to be maintained in the absence of all commercial or friendly treaties, than if those conventions had been renewed as before." Notwithstanding such prudent advice from a master mind, we have since made treaties with Burma; and for the sake of history, to be just and impartial, it must be said that in these matters our policy towards the Golden Foot has not always been in the right direction. For instance, in the treaty of 1867, we first ratified it, saying not a word about the "arms," and then repudiated the arrangement! In future, very great care should be taken in making treaties with Oriental potentates. Let us rather have no treaties at all with them; it is impossible for the Oriental mind to understand the solemn nature of a treaty. It is pleasing to read, while closing these few remarks, that English agents have been in China persuading the Chinese Government of the special importance of its western provinces, which, if the information be correct, argues well for any attempt by Great Britain to open trade through Burma or from Assam, with South-Western China. Here we are free from troubles, while China continues suspicious of the designs of Russia, and we determine that the great aggressive power shall not come to the southward. In February of the present year (1880), we read of the Russian Government (with reference to a treaty in which Russia engaged to provision Chinese troops while operating against Kashgar rebels) having prohibited commercial caravans from crossing the Siberian frontier into Chinese Mongolia. A recent treaty concluded by the Chinese Ambassador, at St. Petersburg, was "too one-sided a document" to be approved at Pekin. The Chinese refusal to ratify the draft was answered by the discontinuance of commercial relations on the confines of the two empires. Russia had now forbidden her subjects to sell provender to the Chinese commanders; and so a diplomatic and commercial estrangement was thought to be complete. This may be considered, on the whole, good news for British commercial interests in Eastern Asia, as China will now turn with more confidence than ever to Great Britain, especially after our diplomatic victory over her wily adversary at Cabul; and the rising young Chinese monarch may just think of turning his attention to British prosperity and influence in Burma with the view of such being extended to South-West China. And so would Russia be checkmated in nearly every corner of the East. As I have remarked elsewhere, at Bhamo, where Burmese and Chinese influences commingle, we hope yet to see—and the Chambers of Commerce fully indulge in such a hope, notwithstanding the obstacles which have gone before—an exchange mart for the silk,

copper, gold, drugs, and textile fabrics of Western China, and for British and Burmese staples.

A "peripatetic" writer in the *Times of India*, some nine years ago, remarked with great force:—"The road to China for us is through Upper Burma or Burma proper. Through Bhamo, the richest side of China can be tapped. The most romantic dreams of the most sanguine have never come up to the reality which may reasonably be expected, as soon as there is a clear passage for trade from Yunnan or Hunan to Rangoon." Rangoon will become the Bombay of the Chinese and Burman empires, and something more. The local advantages of Upper Burma, in reference to trade with Western China, were forcibly brought forward during the visit of the Burmese Embassy to England, in 1872.

The council of the ever-zealous Halifax Chamber of Commerce gave the Envoy an extraordinary welcome, stating in their address to his Excellency, that the "Council having always considered the rich products and fertile lands of Burma, as affording great inducements to the spread of commerce and agriculture, have from time to time carefully considered the many projected trade routes through the possessions of his Majesty the King, to open up a commercial highway to the unlimited resources of Western China." In his reply, "The Envoy Extraordinary and Minister Plenipotentiary from his Majesty the King of Burma," said, with a degree of common sense not always found in Orientals:—

"In reference to the question of trade routes through Burma to Western China, I need merely repeat what I have said in other places, that his Majesty the King of Burma is most anxious to promote, by every means in his power, any matured and feasible plan which has this object in view. But in regard to the route to which you advert, commonly known as Captain Sprye's route, I would remark that, as the line passes through an insignificant portion of the King of Burma's territory, the responsibility of opening it out cannot fairly be laid upon his Majesty."

Although the proverbial golden silence is here observed, it is not difficult to see that the Envoy thought the route from Mandalay to Momien *viâ* Bhamo, the only feasible one, which it most probably is. Certainly, judging from the past, and the troubles we have experienced in our various missions of exploration, the route from Assam to Sze-Chuen strongly advocated by Sir G. Balfour deserves serious attention from the Imperial Government and the merchants of England. Of the route from Assam (Sudiya) to Sze-Chuen, he writes:—"We then join a part of China singularly free from troubles, a dense population, and great resources in minerals, and very much in want of the tea which Assam can supply." And again, "I admit that in minerals Yunnan is rich, but in population very scanty, say from 60 to 100 per square mile, whereas Sze-Chuen has 200 to 250, and is close to Sudiya in Assam." The population of Yunnan, therefore, would appear to come nearer that of Chin-India generally, where, in a surface of 700,000 square miles, there are only about 36 persons to every square mile; while Sze-Chuen, taking Sir George's figures, approximates to Great Britain, with say, 240. British and Upper Burma both sadly require population. In the event of our one day being compelled to possess the country to the northward of Pegu, what a boon it would be to our Eastern Empire, if there was a steady emigration into our new conquest from Sze-Chuen of some 2,000,000! What an impetus it would give to trade and mining operations in Upper Burma; while, if Pegu only had another two millions of peaceful inhabitants from the well-disposed trading Shans and other useful tribes, Southern Burma alone would have nearly as large a commerce as a fourth of that of the whole of India! Really, the commerce of this portion of our Eastern Empire deserves the most serious attention of Englishmen, who have always prided themselves on being the leading merchants of the world. In commercial importance, in my humble opinion, there is no other Eastern question can approach it. It is now upwards of eight years since the question of trade with South-Western China was prominently brought before the British public. The local advantages of a route through Upper Burma, *viâ* Bhamo, were then strongly insisted on; and in addition to other signs of a growing interest in the project, a valuable paper was read before the Society of Arts on the subject. It was then considered that the means of turning the stream of life and commerce away from the old route, by the Straits of Malacca and the Chinese Sea, in a new direction, as well as a better and a more secure one, "must first be found in easy steam communication; and then, with Burma as the highway, Great Britain and India would have no difficulty in tapping the resources of South-Western China, and also other adjacent States." Canals and roads would come after, and so would railways; but, somehow or other, the subject for a time lost its interest. Now, it should be revived ten-fold, not only on account of the continued prosperity of Pegu, or British Burma, but from its becoming tolerably apparent by the state of the political barometer in the East, that the days of Golden Foot rule at Mandalay are numbered. At the time above mentioned, our Government had only contemplated making a railway from Rangoon to Prome. Now, that is finished, and the snort of the iron horse should go bravely on to the northward. With reference to the Burmese Embassy to England, some eight years ago, I have already referred to Captain Sprye's route to South-Western China. An Edinburgh Reviewer, in a most interesting article on the trade routes to Western China, writes:—His project aimed at connecting the port of Rangoon, on the Irrawaddy, with Esmok, a Chinese town in the extreme South of Yunnan, by means of a tramway, which should be carried diagonally across Pegu and Burmah, passing by the town of Shwé-gyeen, on the River Salwen [the reviewer here is in error, it should be the Sittang], and thence proceeding to its terminus, at what the projector believed to be an important entrepôt of Chinese trade. "But, as it turned out, this Esmok is in reality no centre of commerce, except for some good tea, but a mere frontier post on the verge of the Chinese dominions. And that the route by which it was proposed to reach this point abounded in well nigh unsuperable obstacles." It is just 20 years since the Chambers of Commerce first took up the idea of this route, which, though far from comparable with that *viâ* Bhamo (the emporium of commerce between Burma and Yunnan), to which attention was first called by Dr. Williams, is, nevertheless, honourably associated with the name of Captain Sprye, who did his utmost to advocate the opening of trade with Western China. In time to come, probably, both routes, and others that at present we know not of, will be available for capitalists from England and India. Trading centres will multiply in Burma and South-Western China; and France, in Cochin China and Tonquin, jealous of our vast power and resources from the possession of Burma, will, Sphynx-like, with earnest eyes, be looking on at China's old exclusive propensities giving way.

The Englishman, too, will wonder how, towards the end of the 19th century, Western and Central Asia occupied so much and Eastern Asia so little of our attention. The keen Chinaman, and especially the ever busy Shan, as far as we are concerned, are at present far too little known among us. Tasteful Shan ladies, with their love of jewellery and elegance of design, may yet give a fashion to Belgravia; and the Shans, being famous workers in straw, may yet produce hats for the park rivalling the Tuscan in quality, and in shape that of the far-famed beautiful "Duchess." Our blacksmiths may yet take a lesson from the Shans in the forging of

a sword from iron brought from Yunnan, and British merchants will be delighted to observe that among the arts in which the "self-sufficing" people are proficient is that of manufacturing cotton cloths.

Of course the concurrent commercial interests of British and Upper Burma and China are also those of India and England; and when Western China is really opened up to British enterprise it will probably be one of the greatest boons which commerce ever received. The force of civilisation, if not war, must eventually knock the Golden Foot entirely out of the way. Our present relations with Upper Burma are in a very unsatisfactory condition, and the events of the last few years have produced coolness and distrust between the British and Burmese Governments. "The violence," continues an admirable critic on the situation, "offered to the exploring party to Yunnan, under Colonel Sladen, the determined attack led on that by Colonel Browne, the murder of Mr. Margary in Chinese territory, &c., have all contributed to widen the breach, which has ended in the withdrawal of the British Resident; but on the whole," he thinks, "that the occupation of British Burma—with an area of 130,000 square miles, including the tributary Shan states, and numerous wild and troublesome tribes—would involve difficulties which it is not desirable, except from dire necessity, to encounter. If we can have a free right of way through for trade with China, with the goodwill both of Burma and China, that would be far better for British material interests, and British honour, than the violent act of annexation." It is clear that something decided must soon be done, for commerce is a fearful sufferer by the present state of Burmese affairs. Even the few manufacturers of Mandalay have fled. The silk cloths and silver work are no more. Lead circulates for copper, and the State lotteries have ruined the country.

The concurrent commercial advantages of India and Burma become more and more fixed on the mind when we compare the two countries. In a review of the trade of British India with other countries for 1878-79, we find it stated that, "although India possesses a long coast line of over 9,000 miles, and about 300 harbours, the foreign trade of the empire is practically confined to the five ports, which are the capitals of the five great littoral provinces, viz., Calcutta, Bombay, Madras, Rangoon, and Kurachee, all of which, excepting Madras, are excellently situated as central marts for the distribution of articles of commerce. To Rangoon naturally flow by the Irrawaddy all the products of Upper Burma, and of Pegu, the most valuable of our possessions in the Burmese peninsula; while the railway already open (for 163 miles) between Rangoon and Prome offers further facilities for the conveyance of merchandise." And it is still more interesting to find that intelligent Englishmen are gradually becoming alive to the fact that the most thriving place, commercially, in the Indian (or Eastern) Empire, considered relatively to its size, is Rangoon. And there can be no doubt that British Burma, even at present, is the most prosperous province in the Empire, with a people free from religious and caste prejudices, more fond of "personal comfort and adornment" than either Hindus or Mahomedans, and, consequently, more ready and eager in the pursuit of civilised commerce than their more apathetic neighbours. It is fairly well known that much of the foreign trade of India is shared between England and China. Still the proportion of the trade carried on directly with England is not increasing, but slowly the reverse. At present, Indian trade with China is practically confined to the opium trade. What a much more noble trade would that be, coming from the profitable manufacture of cotton in Western China, and its despatch, *via* Rangoon, to India! With the expert Chinese, such manufacture, aided by the other valuable mercantile productions of Yunnan and Sze-Chuen, would probably pay well in the end; and it has been truly said that the Chinese are better adapted for profitable cotton manufacture than the people of India. China is at present compelled to import cottons, in which India has the advantage of the flowery land. In the omnipotent article of cotton, then, until China be compelled to grow more, there is ample room for the spinnings of India, Burma, and Manchester; and no greater impetus could be given to this most useful trade (or branch of industry), and the furthering of general acute and bold commercial speculation in other commodities throughout Eastern Asia, than would be derived from opening up through Northern Burma, the long-neglected provinces of South-Western China. Such a consummation would be the first grand wedge driven into the mighty mass of Chinese or Mongolian seclusion, making a rent which, commencing with our humble conquests of Arakan, Tenasserim, and Pegu, might eventually bring 400 millions of the human family under the direct civilising influence and control of Great Britain.

MISCELLANEOUS.

OPIUM TRADE OF INDIA.

By P. L. Simmonds.

The deficiency of the Indian revenues to meet the war expenditure has necessarily drawn public attention to the current sources of taxation. After the land revenue, which brings in 21 to 22 millions sterling annually, salt and opium are the chief sources of dependence; salt yielding about 6½ millions, and opium (the production and sale of which is a Government monopoly) 8½ to 9 millions sterling. It may be worth while to give the details of the opium export, and I draw the figures given below from various official publications, the "Statistical Abstract relating to British India," the "Annual and Monthly Statements of the Trade and Navigation of British India," "Miscellaneous Statistics of British India," "Statements of the Moral and Natural Progress and Condition of India," and "Reviews of the Trade of British India by J. E. O'Conor."

The progressive growth of the opium trade is shown in the following figures:—In the year 1800, about 5,000 chests were exported; in 1825, 12,000; in 1850, 50,000; in 1860, 58,000; in 1870, 88,000; and in 1880, 105,000. The acreage devoted to the culture of this drug is said to exceed 1,100,000 acres; immense tracts of the finest and most fertile land in Northern and Central India are now covered with poppy plantations.

The following table shows the quantity and declared value of the Indian opium exported during the last 25 years:—

	Chests.	£		Chests.	£
1855	77,397	6,231,278	1868	87,139	12,330,800
1856	70,626	6,200,871	1869	74,955	10,695,654
1857	72,385	7,056,630	1870	88,683	11,693,330
1858	74,966	9,106,635	1871	85,518	10,783,863
1859	75,822	10,827,642	1872	93,364	13,365,228
1860	58,681	9,054,394	1873	82,908	11,426,280
1861	63,490	10,184,713	1874	88,727	11,341,857
1862	65,369	10,553,912	1875	94,746	11,956,972
1863	82,216	12,494,128	1876	88,350	11,148,426
1864	70,839	10,756,093	1877	96,870	12,404,748
1865	84,492	9,911,804	1878	92,820	12,374,355
1866	88,439	11,122,746	1879	91,200	12,993,979
1867	74,855	10,431,707			

Dividing off these 24 years into five equal periods, we have the following results:—

	Average No. of Chests Exported.	Average aggregate value	Average value per Chest.
		£	£
1854-55 to 1858-59	74,239	7,844,611	106
1859-60 to 1863-64	68,119	10,608,648	156
1864-65 to 1868-69	81,976	10,898,542	133
1869-70 to 1873-74	87,840	11,722,111	133
1874-75 to 1878-79	92,797	12,175,696	131

The decrease in the quantity exported in 1878-79 followed on deficient crops in Malwa. The export, however, in the present year, ending 1st April, has been larger than usual, reaching 105,507 chests, of the value of £14,323,314.

The aggregate weight of the opium shipped can be given for the last few years; it was, according to the official returns, in 1876, 120,781 cwt.; 1877, 130,775 cwt.; 1878, 126,789 cwt.; 1879, 125,765 cwt.; and 1880, 144,638 cwt. The export trade is tolerably equally divided between Bombay and Calcutta, and in both places is mainly in the hands of the Jews. The bulk of the shipments goes to Hong Kong—59,633 chests in 1880; and 35,202 to the treaty ports, and of the rest, the largest proportion, 10,586 chests, were sent to Singapore.

WOOLSORTERS' DISEASE.

Dr. J. H. Bell has recently read a paper on this disease before the Bradford Medico-Chirurgical Society, which is printed in the *Lancet*. These researches bear upon the subject treated by Dr. Richardson in his lectures before the Society of Arts, on "Unhealthy Trades," in 1876.

"The sorting of wool is generally considered a healthy occupation, but the sorting of hairs, which are classed with wools, such as alpaca and mohair, has long been known to be attended with considerable risk to life. During my inquiry into the causes of this, I have found sufficient reason to include with them as similarly dangerous, all wools and hairs which are characterised by being dry, dusty, and more or less filthy from contamination with decomposing animal matter, and particularly if they contain 'fallen fleeces' from diseased animals. Among these are all kinds of alpaca, goat's hair, camel's hair, low-class East Indian, Persian, and such like wools. The sorting of these is injurious to health: first, from the dust and fine short hairs which arise from them, exciting chronic diseases of the lungs, as bronchitis and consumption; second, from the amount and virulence of poison from decomposing animal matter which is liberated, producing a low form of pneumonia, which I may call septic pneumonia; third, from a specific blood-poison, derived from the fleeces of animals which have died from anthrax, producing the rapidly fatal disease called 'woolsorters' disease.'

"I have tried to ascertain the comparative health of persons sorting different kinds of wool, and find that the annual amount of sickness of the alpaca, mohair, and camel's-hair sorter, is almost double that of the British and Colonial woolsorter.

"The number of deaths from diseases of the lungs, excluding phthisis, in the Bradford registration district, of males aged twenty years and upwards, for the ten years 1851-60, was 17·4 per cent. of the total deaths at these ages. In the Shipley sub-district, where alpaca and mohair are largely used, the proportion for the five years, 1872-6 was 68·2 per cent. This excess of deaths from lung diseases (nearly four to one) does not apply to sorters of wool in other sub-districts where these dangerous hairs are not used.

"Alpaca and mohair were introduced into the Bradford district as textile materials about the year 1837. It was not until some years had passed that a suspicion arose among the workpeople that they were injurious to health; this was confirmed by time, and the disease, which could not be accounted for, was found to be confined to the sorters, and became known as 'sorters' disease.' At places where these materials are used in large quantities, sudden deaths of sorters are frequent. When these occur singly, and at some weeks' interval, little notice is taken of them; when, however, several men working together in the same room die from this mysterious disease within a short time of each other, considerable disquietude and alarm are caused among the workpeople, but only for a short time; the excitement soon subsides, and the work is continued. Men are willing to run the risk without complaint, and submit quietly to what they consider to be inevitable, although scarcely a month passes without the record of some death within the district from this disease.

"At various times, eminent medical and scientific men have been consulted by different firms; *post-mortem* examinations, investigations, and reports have been made over and over again, without satisfactorily explaining its cause and nature, or lessening its frequency. It has now prevailed and been recognised in this neighbourhood about forty years, and notwithstanding all that has been done to prevent it, by ventilation, the use of respirators, and other means, it still continues, as severe and frequent as it ever was, overclouding the life of the sorter with a mysterious shadow, and threatening him daily with death."

The paper concludes with the report of a large number of cases.

"TONGA"—A REMEDY FOR NEURALGIA.

Under the name of "tonga" a new remedy for neuralgia has recently attracted considerable attention among the medical profession. "Tonga" was introduced to this country from Fiji, some months since, with the account that "it has been used some years by the Aborigines of the Fiji Islands, and a European who married a chief's daughter, learned the secret from his father-in-law, in whose family the knowledge of the composition of this remedy had been an heirloom for upwards of 200 years." The peculiarity of the new drug is the rapidity of action on the nerves, which it is credited to possess, and the singular manner or form in which it has been brought to this country, namely, in small broken fragments consisting of a mixture of woody fibre, bark, and leaves broken up into such small pieces as to make it almost impossible to identify any portion botanically. This broken vegetable matter is tied up into spherical bundles, each about the size of an orange. The wrapper of these bundles consists of the fibrous sheathing base of the leaves of the cocoa-nut palm (*Cocos nucifera*).

The mode of preparing a draught of tonga for use is extremely simple. The bundle, while still closed, is to be allowed to soak in cold water for ten minutes. The liquid is then to be squeezed out into a tumbler, and a claret glass of the infusion taken three times a day, about half an hour before each meal. The bundle is to be dried and hung up in a dry place, and can be used over and over again for a year. This peculiar substance has been tried in this country by medical men, and very successfully reported upon, effecting a cure, it is said, in the second or third clay. Notwithstanding the broken state of this drug, as it has appeared in this country, Mr. E. M. Holmes, the curator of the Museum of the Pharmaceutical Society, has, after careful examination, arrived at the conclusion that the principal component part of the contents of the bags to be the stem of an arvideous plant, a species of *Rhaphidophora*, probably *R. vitiensis*.

SIEMENS'S APPLICATIONS OF THE DYNAMO-ELECTRIC CURRENT.

Dr. Siemens, F.R.S., read a paper last week upon "Recent Applications of the Dynamo-Electric Current to Metallurgy, Horticulture, and the Transmission of Power," before the Society of Telegraph Engineers. He first referred to the inaugural address which he had given before the society on his election to his second Presidency, wherein he drew attention to the applicability of the dynamo-electric current to purposes beyond the range of what electricity had theretofore been employed in effecting. On the present occasion he corroborated his statements by a reference to recent experimental results of his own. The first part of the paper had reference to an electric furnace, which was fully described, and by whose means a kilogramme of mild steel was melted before the audience, the first time in a quarter of an hour and the second time in eight minutes.

Electro-Horticulture.—In the second portion of the paper, the author explained the experiments by means of which he has come to the conclusion that electric light produces the colouring matter, chlorophyll, in the leaves of plants, that it aids their growth, counteracts the effects of night frosts, and promotes the setting and ripening of fruit in the open air. It appears, further, that, at all events for certain short periods, plants do not require a period of rest during the 24 hours, but make increased and vigorous progress if subjected during daytime to sunlight and to electric light at night. These observations on combined sun and electric light agree with those made by Dr. Schübeler, of Christiana, who found as the result of continued experiment in the north of Europe during an Arctic summer that plants, when thus continuously growing, develop more brilliant flowers and larger and more aromatic fruit than when under the alternating influence of light and darkness. As Dr. Siemens has found that under the influence of electric light plants can sustain increased stove heat without collapsing, he is of opinion that forcing may be effected in an electric stove or enclosure containing an electric light, and that horticulturists may thus grow fruit of excellent aroma and flowers of great brilliancy without immediate solar aid. To test what can be done practically, the author has put down a steam-engine and boiler at his country residence near Tunbridge Wells, and intends to test the principles involved upon a working scale during the winter. The steam-engine which drives the dynamo-electric machine during the night for the purpose of giving light is to be employed during the day in transmitting power through an electric conductor to the farm for the purpose of carrying on small farming operations, such as turnip, chaff, and wood cutting, &c. Another interesting question which Dr. Siemens has set himself to answer is to determine which portion of the rays constituting white light is efficacious in producing chlorophyll, starch, and woody fibre, and which in effecting the ripening of fruit. For this purpose arrangements are in preparation to distribute the spectrum of a powerful electric light in a darkened chamber over a series of similar plants exposed *seriatim* to the actinic, light-giving, and thermal portions of the spectrum. Some experiments have been made with solar light in this direction, but no very conclusive results could be obtained, because the short periods of time during which the solar spectrum can be maintained steadily in the same place are so short that the effects produced upon vegetation have not been of a sufficiently decided character; whereas, with the aid of the electric light, the same spectrum may be kept on steadily for a series of days without intermission. The author referred shortly to the lamp which he designed for this purpose, having a focus unchangeable in space, and without obstruction to the rays of light falling downward. There is no clockwork; the carbons are pressed forward either by their own weight or by the force of springs, the motion being checked by an abutment against which the carbon presses at the junction of its cylindrical with its conical portion. This is at a distance of 1-3 in. to ½ in. from the arc centre, when the heat is sufficient to cause the gradual decomposition of the carbon, without being high enough to fuse or injure the metal abutment.

Electric Railway.—In the third portion of the paper, the author refers to the application of electricity as a means of mechanical propulsion. He described the electric railway designed by Dr. Werner Siemens, of Berlin, and tried at a local exhibition held in that city. The rails were insulated from the earth by wooden sleepers, and were in electrical connection with a dynamo-electric machine worked by steam power at the station. A magneto-electro machine on the driving carriage was so fixed and connected with the axle of one pair of wheels as to give motion to the same, the driving axle being severed electrically by the introduction of an insulated washer. A current of electricity is thus passed along one rail to work the magneto-electric machine on the driving carriage, and back by the other rail to the stationary machine on the ground. The author anticipates a large application of the electric railway to adits in mines, to locomotives between neighbouring places, and to tunnels. In fact, it is seriously contemplated to apply this system at the St. Gothard Tunnel, where the large turbines are available which have been employed in the boring operations.

CORRESPONDENCE.

IMPROVEMENTS IN VIOLINS.

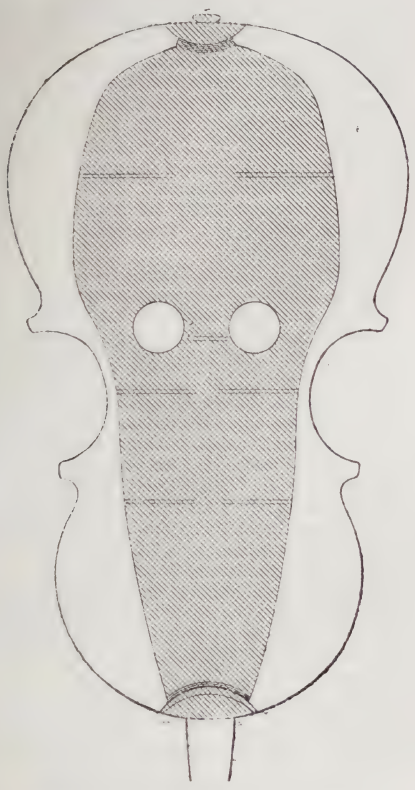
You are already informed that for the last two or three years I have made a number of experiments with a view to improve the violin, and should have been happy to state the result before a meeting of the Society in order that they might hear the instruments and judge for themselves, but as no opportunity of doing so has occurred, I shall feel obliged if you will afford me a short space in the *Journal* to describe the instruments as I have had them altered. My improvements are not patented, and anyone who pleases is, therefore, at liberty to use them.

My experiments resulted in the insertion of a central sound-board, or diaphragm midway between the back and the belly, attached firmly to the two end blocks, but not touching either the sides, belly, or back, so that it is free to vibrate from end to end. I give a drawing (see p. 647), drawn to a scale of one-fourth of an inch to an inch. The short line between the two holes shows the position of the bridge. Under each of the sound holes is a hole in the diaphragm one inch and a quarter in diameter. The object of these two holes is to allow the sound free circulation, one of them being also required for the insertion of the sound post. The lower end of the diaphragm is also sloped off on each side until it meets the neck block in order further to promote the circulation of the sound. The diaphragm is perfectly flat, and about one-ninth of an inch thick throughout, made of the finest Swiss pine. In order to prevent a reedy tone by the vibration of the wood across the grain, six very slender cross-bars are glued across the diaphragm, just sufficient to tie the threads of the wood together. Mr. Furber, the violin-maker who carried out my instructions, made a diaphragm for one of his violins of sycamore, without cross-bars, which answered equally well.

The diaphragm requires almost as much care in its manipulation as the belly; I had several made before I could find the right proportions.

The instrument I operated upon was an ordinary one; the tone, previous to alteration, was of a thin character, and unequal on different parts of the finger-board; whereas now it is fuller, of a finer quality, and remarkably equal throughout its whole compass.

Inequality of tone is a common fault in many violins, and I may, perhaps, venture a speculation why the diaphragm corrects it. Probably, where the vibration of the belly on some notes is deficient, the vibration of the diaphragm, which operates under different conditions, comes to its aid.



I think there is much hope of improvement in what I will term the voicing of the violin by internal arrangements. I have made a number of experiments in this direction, some of them with good results, but I think the central diaphragm is the best I have yet tried.

I cannot say from one experiment which is best, the flat diaphragm or the vertical bar; the latter is more simple and easier of application: it gives improved power and tone with great equality throughout the compass. The harmonic sounds are remarkably clear and full. I think it probable that the bar would be improved by making the space between the outer and inner arcs of the circles only quarter of an inch. This would give greater elasticity and more room for the expansion of the sound, and I think would be strong enough, provided that the arcs of the outer circles should not be produced until they touch each other, but should be joined by a short curved line so as to leave at least half-an-inch of wood between the arcs of the circles. I have shown in two of the circles in the margin an illustration. There would thus be half-an-inch depth of wood along the whole bar.

I do not claim the origination of this contrivance; it is merely a modification of a central bar from block to block, for which a patent was, I believe, obtained about 15 years ago, and which, Mr. Furber tells me, had an extensive run for some time. This bar was solid and stiff, and had for its object the tightening of the belly and preventing its being forced up by the longitudinal tension of the strings, which sometimes does happen, especially to weak instruments. My modification of this bar gives a certain amount of elasticity which assists vibration, while it is sufficiently firm to strengthen the belly.

It seems strange that the violin should have remained unchanged for centuries, while almost all other musical instruments have been improved; modern makers usually follow the modes of the Italian school, but, however, exactly they may gauge and measure a Straduarius violin, and imitate its form and structure, the copy gives an inferior result. The art of violin making appears never to have been reduced to exact and scientific rules; even the eminent Italian makers scarcely made two instruments exactly alike in power and tone, and it is difficult to assign the reason for the great superiority of their instruments. I think, however, that one of their secrets was the careful choice of sonorous wood; and here I think is a hopeful field for investigation, in which the use of the microscope would, perhaps, give us an advantage over the ancients.

In the process of seasoning wood, the moist portions of the sap are dissipated, and on examining the wood with a powerful glass I have observed that the wood is traversed by minute cells and little ducts, and that the sides of these diminutive veins and arteries (so to speak) which run through the wood are varnished, as it were with a very thin film of the resinous or glutinous remains of the sap; the substance of the seasoned wood is, in fact, a series of minute air cells and pipes, and the form and arrangement of these differ much in different woods, and even in different parts of the same tree. I have not made any experiments to enable me to form an opinion on the relation between the microscopic appearance of the wood and its sonorous properties. The investigation of this subject, to any useful purpose, would involve long and laborious experiments and researches; but it seems probable that the Italian makers had some rough and ready rules to guide them in the choice of sonorous wood, for we find, as noticed in Mr. Hart's book on the violin, that much time and labour were employed by some of them in neatly joining small pieces of wood in their instruments, which evidently showed a desire to economise rare material.

H. WALDUCK.

GENERAL NOTES.

Africa.—The Council of the German African Society has now arranged with the King of Belgium, as president of the International African Association, that, instead of carrying out their former intention of establishing a German station on the southern bank of Lake Tanganyika, their expedition, which is now at Zanzibar, preparing for their tour into the interior, shall first establish a station at Mangasa; that, however, the right to found a second station near Lake Tanganyika shall be reserved to them. Dr. Pogge, of Mecklenburg, already well-known through his African travels, will become the director of this second station, which will now perhaps be established at Mus-

sumba, the capital of Muata Tamwo. This station will form a link in a complete chain of small settlements which are to extend all over the Dark Continent.—*Nature.*

Sydney Exhibition.—The Sydney International Exhibition was officially closed on the 20th of April by Lord Augustus Loftus, the governor of the colony, in the presence of a large assemblage. The admission to the "Garden Palace" during the time it was open exceeded the most sanguine expectations, being about 1,022,000, without including the closing day. The amount received for admissions and concessions was about £45,000. This sum, though not quite equal to the original estimate of £50,000, would probably defray the ordinary working expenses of the exhibition. The total attendance was regarded as unprecedented, considering the sparse population of this great colony, and the distance from the other Australian colonies and other parts of the world. The number of judges was 204, besides the 100 judges at the auxiliary shows of live stock, wool, &c., and shows illustrating the vegetable kingdom. There were 7,070 awards sent in by the judges, and their reports will be published in a volume.

St. Gothard Tunnel.—A difficulty has arisen in the St. Gothard Tunnel, which, according to the *Times* correspondent, threatens seriously to retard the completion of the undertaking. In a part of it, where the formation is a porous white stone, the vaulting has already given way two or three times, and it has required the greatest care and constant staying with timber to prevent the passage thereabouts from completely collapsing. It was thought, however, that a granite wall 6 feet thick would be sufficiently strong to support the superincumbent mass of white stone and keep the tunnel permanently open. A wall of this thickness has just been finished, but it too has begun to give way, and the engineers are at their wits end how to overcome the difficulty. In the opinion of of Dr. Stapf, the geologist of the tunnel, it can be overcome only by making a wide curve so as to get round the white stone instead of going through it. This would involve the entire reconstruction of that part of the tunnel, in which case it will probably not be ready for traffic before the time fixed for the completion of the lines of approach, two years hence.

Lectures to Ladies.—The Executive Committee have just reported on the present condition of the classes for ladies, under the superintendence of the Professors of King's College, London, which have been held at No. 5, Observatory-avenue, and in the Vestry-hall, Kensington. The general result is satisfactory, and the balance-sheet shows that the undertaking has been self-supporting. The committee consider that the time is "come for determining in what way permanence may be given to the undertaking, which has proved its importance and value by the considerable success of the last three years. This can, they think, only be done by forming a College for Women, on the same general principles as those on which King's College has now worked for about 50 years. It is possible to do this without any considerable difficulty or expense, by forming an association under the 'Companies Acts, 1862 and 1867,' and it would appear that the one necessary preliminary is the raising a sufficient sum of money to erect or purchase a suitable building."

Hotel de Ville, Paris.—The works connected with the rebuilding of the Hotel de Ville are at length approaching completion. The top courses of stone having been commenced, this will allow of the construction of the stonework of the great clock, which, like the rest of the building, is to be a reproduction or adaptation in perfect keeping with the design of the famous old building, or, rather, of the old portion of the former, which possessed far more architectural character than the additions of later date. Most of the statues will be replaced, and many of these are all ready to be raised to their places. It appears that 4,400 cubic mètres of stone have already been placed, and more than 800 cubic mètres of brickwork executed. The surface of *hourdis* (hollow pottery work laid in between the floor joists, which has a good effect in deadening sound) laid to the present time is just below 4,000 mètres, and the heavy iron employed has exceeded 200 tons. There are 478 workmen employed about the building, and the number of days' work on the building and in the quarries has amounted to 28,522. The total outlay to November last was 8,000,000 francs, and this has since been increased by upwards of half a million.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 14TH...Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Sir Richard Temple, Bart., G.C.S.I., "The Highway from the Indus to Candahar."

Victoria Institute, 7, Adelphi-terrace, W.C., 8 p.m. Paper by the Right Hon. Lord O'Neill, K.P.

TUESDAY, JUNE 15TH...Women's Protective and Provident League (at the HOUSE OF THE SOCIETY OF ARTS), 8½ p.m. Sixth Annual Meeting.

Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Mr. R. Price Williams, "The Increase of Population in England and Wales."

Zoological, 11, Hanover-square, W., 8½ p.m. 1. The Secretary, "Additions to the Menagerie during the month of May." 2. Mr. W. A. Forbes, "The Anatomy of *Leptosoma discolor*." 3. Mr. Edward R. Alston, "*Antechinomys* and its Allies." 4. Mr. G. E. Dodson, "Some new or rare species of Chiroptera, in the collection of the Göttingen Museum."

WEDNESDAY, JUNE 16TH...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 8½ p.m. *Conversazione* at the South Kensington Museum.

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Dr. J. Mulvany, "Ozone in Nature; its Relations, Sources, and Influences." 2. Mr. Henry Storks Eaton, "The Average Height of the Barometer in London." 3. Lieut. Alfred Carpenter, "Note on a Waterspout observed at Morant Cays, Jamaica, March 23rd, 1880." 4. Captain James Templar, "Account of a Balloon Ascent in a Whirlwind, March 23rd, 1880." 5. Mr. William Marriott, "Results of Meteorological Observations made at Stanley, Falkland Islands, 1875-77." 6. Mr. William David Bowkett, for exhibition, "Winstanley's Air Thermometer."

THURSDAY, JUNE 17TH...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. F. M. Campbell, "A Stridulating Organ in *Lyniphia terricola*, and in *Steatoda guttata*." 2. Mr. S. O. Ridley, "Two Cases of Incorporation by Sponges of Spicules foreign to them." 3. Mr. F. M. Campbell, "Certain Glands in the *maxillæ* of Spiders."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. T. Takamatsin and Mr. Watson Smith, "Pentathionic Acid". 2. Mr. Harry Baker, "A Crystal of Diamond." 3. Mr. J. Stenhouse and Mr. C. E. Groves, "Orcinol Derivatives." 4. Mr. R. Warrington and Mr. W. A. Peake, "The Determination of Carbon in Soils." 5. Dr. E. Armstrong, "Note on Camphydrene." 6. Mr. A. G. Perkin, "The Action of Nitric Acid on Diparatolylquanidine." Ballot for the election of Fellows.

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Morning Meeting at Lambeth-palace.

Numismatic, 4, St. Martin's-place, W., 7 p.m.

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

FRIDAY, JUNE 18TH...Royal United Service Institution, Whitehall-yard, 3 p.m. Major-Gen. Sir Frederic J. Goldsmid, "From Bamean to Sonmeanee Bay."

Philological, University College, W.C., 8 p.m.

Royal Botanic, Inner-circle, Regent's-park, N.W., 3 p.m. Prof. Bentley, "The Functions of Plants and their Organs of Production." (Lecture VII.)

SATURDAY, JUNE 19TH...Geologists' Association, University College, W.C. Excursion to Croydon and Riddlesdown, under the direction of Mr. Logan Lobley.

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, JUNE 18, 1880.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Twenty-sixth Annual General Meeting, for the purpose of receiving the Council's Report and the Treasurer's statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new Members, will be held, in accordance with the Bye-laws, on Wednesday, the 30th of June, at 4 o'clock p.m.

The Council think it well to call the special attention of Members to the above notice, and to express their hope that Members may find it convenient to attend and receive the report of the Council on the work of the Session.

(By Order of the Council)
H. TRUEMAN WOOD,
Secretary.

THE ALBERT MEDAL.

The Council of the Society of Arts attended, on the 14th inst., at Marlborough-house, when his Royal Highness the Prince of Wales, as President of the Society, presented to Sir William Thomson, L.L.D., D.C.L., F.R.S., the Albert Medal, awarded to him in 1879 "on account of the signal services rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables;" and to James Prescott Joule, D.C.L., F.R.S., the Albert Medal for the present year, awarded to him "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording the engineer a sure guide in the application of science and industral pursuits." The members of the Council present were:—Lord Alfred S. Churchill (Chairman of the Council), Professor F. A. Abel, C.B., F.R.S., Mr. G. C. T. Bartley, Dr. G. Birdwood, C.S.I., Mr. E. Chadwick, C.B., Major-General F. C. Cotton, C.S.I., Mr. Hyde Clarke, Mr. Henry Doulton, Sir P. Cunliffe Owen, K.C.M.G., C.B., Mr. W. H. Perkin, F.R.S., Mr. R. Rawlinson, C.B., Mr. C. W. Siemens, L.L.D., F.R.S., and Mr. James A. Youl, C.M.G., with Mr. H. Trueman Wood (Secretary), and Mr. Henry B. Wheatley (Assistant Secretary).

CONVERSAZIONE.

The Society's *Conversazione* was held at the South Kensington Museum (by permission of the Lords of the Committee of Council on Education), on Wednesday last, 16th June. The Galleries containing the Raphael Cartoons, the Sheepshanks Collection, the William Smith Collection of Water Colour Drawings, the Dyce and Forster Pictures, the Collections of Paintings lent by Lord Spencer, and by the Trustees of the late Rev. Pryce Owen, "The Chantrey Bequest," and the Schliemann Collection of Objects from Troy, as well as the Courts and Corridors of the Ground Floors, were open, the east side of the South Court being lighted by the Brush Electric Light. The reception was held in the Architectural Court, by Lord Alfred S. Churchill, Chairman, assisted by the following Vice-Presidents and Members of the Council:—Mr. Hyde Clarke, Mr. B. Francis Cobb, Sir P. Cunliffe Owen, K.C.M.G., Mr. Robert Rawlinson, C.B., Dr. Siemens, F.R.S., and Mr. J. A. Youl, C.M.G.

The Fothergill Gold Medal, awarded to Mr. Donald Currie, M.P., "for the improvements he has introduced into his Passenger Steamers, having for their object the prevention of loss of life at sea from fire or accident," was presented by the Chairman.

A Promenade Concert was given by the Band of the Royal Artillery (Conductor—Mr. Smyth), in the North Court, the following being the programme of music performed:—

Priests' War March	"Athalie,"	Mendelssohn.
Overture	"Stradella,"	Flotow.
Operatic Selection	"Mignon,"	Thomas.
Serenade	"La Calma,"	Bazzini.
Cantata	"Adelaide,"	Beethoven.
Turkish Patrol		Michaelis.
Operatic Selection	"Madame Favart,"	Offenbach.
Prelude and Trio	"I Lombardi,"	Verdi.
Dances	"Ungarische,"	Brahms.
Fantasia	"Faust,"	Gounod.
Gavotte	"Heimliche Liebe,"	Rasch.
Operatic Selection	"Les Cloches de Corneville,"	Planquette.

Vocal and instrumental music, consisting of glees, &c., was given at intervals during the evening in the Lecture Theatre, by the Royal Criterion Hand-bell Ringers and Glee Singers (Messrs. Berry, Campfield, Doyle, Fletcher, James, Taylor, Tipper, and Wise), under the direction of Mr. Harry Tipper. The programme was as follows:—

From 9 to 9.30.

Glee	"Hail to the Chief"	Bishop.
Bells	"Chanson des Domestiques"	Planquette.
Glee	"Hail Smiling Morn"	Spofforth.
Bells	"Selection of Irish Airs"	
Part Song	"O who will o'er the Downs so free"	Pearsall.
Bells	"Imitations of Village Chimes"	
	Introducing several well-known tunes, &c.	

From 9.45 to 10.15.

Bells	"The Harmonious Blacksmith" With Anvil and Triplet variations.	Handel.
Glee	"Strike the Lyre"	Cooke.
Bells	"Selections from 'Les Cloches de Corneville'"	Planquette.
Part Song	"In this hour of softened splendour"	Pinsuti.
Bells	"Bric à Brac Polka"	Coote.
Trio	"Gipsies' Laughing Chorus"	Glover.

From 10.30 to 11.

Glee	"Sigh no more, Ladies"	Stevens.
Bells	"Blue Bells of Scotland, with variations"	
Madrigal	"Down in a Flowery Vale"	Festa.
Bells	"March from Scipio"	Handel.
Part Song	"Good-night, Beloved"	Hatton.
Bells	"Auld Lang Syne"	

The number of visitors attending the *Conversazione* was 2,379.

CONCERT BY SCHOLARS OF THE NATIONAL TRAINING SCHOOL FOR MUSIC.

Arrangements have been made for a concert by the Society of Arts scholars at the National Training School for Music, assisted by some of the other scholars, to be held in the Great Room of the Society, on Tuesday, the 22nd inst., at 3 p.m. As the number of seats is limited, admission will be by tickets only, to be obtained by Members on application, and when a sufficient number of tickets to fill the room have been supplied, the issue will be discontinued. Each ticket is numbered; it will admit one person, and will be transferable. Two will be issued to each Member applying for them. A few tickets still remain, for which Members should make early application.

ANNUAL CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

The following resolutions were passed at the meetings held on Thursday, June 10th, and Friday, June 11th (the Right Hon. JAMES STANSFELD in the Chair):—

I.

"This Conference confirms the resolution passed by the Conference of 1878, in favour of the constitution of County Boards to conduct the ordinary administrative and financial business of the county.

"This Conference is further of opinion that such representative County Boards should be instituted with the least possible delay, and that the functions entrusted to them, and the powers conferred upon them, should be wide and full, and conceived in the view of enlarging, elevating, and re-invigorating the principle of local self-government in this country; and, further, it is the opinion of this Conference that such County Boards, or combinations of them, in preference to newly-constituted authorities, should be charged with the conservancy of rivers, including the prevention of floods, the storage of water, and the preservation of rivers from pollution. And, lastly, that such County Boards should also be charged with the appointment of County Health Superintendents in each county."

II.

"That, in the opinion of this Conference, the Public Health Act of 1875 and the Pollution of Rivers Act of 1876, with other Acts dealing with public health, require revision and amendment in many important particulars, and that the suggested amendments and additional Clauses subjoined, deserve the attentive consideration of Parliament:—

"1. Public Health Act, 1875—

"*a*. By conferring powers, and corresponding duties, upon local authorities with regard to the construction of sewers, and connection of house drains therewith, not less extensive than those conferred upon the Commissioners of Sewers by the 11 and 12 Vic., c. 112, ss. 37, 38, and 46.

"*b*. By amending section 23, and substituting one hundred *yards* for one hundred *feet*, and empowering the sanitary authority to prevent the continuance in old, and the construction in new, houses, of any drain, sewer, or conduit within the building until an outfall for emptying the same has been provided and constructed to the satisfaction of the authority, other than into any lake, pond, river, canal, or water-course.

"*c*. By enabling local authorities in rural districts to construct new sewers and water-supply works for the special service of outlying dwellings, and necessary for their healthful occupation, and charging the cost of the same upon the owners or occupiers thereof, payment to be made within a period not exceeding twenty-one years, the intent of such provision being that rates for sanitary purposes in rural districts, including water supply, should, as far as practicable, fall on those only who are benefited by the improvements.

"2. Pollution of Rivers Act, 1876.—Amendments desirable in the Rivers Pollution Prevention Act, 1876, 39 and 40 Vic., c. 75.

"*a*. By striking out of sections 2, 3, 4, and 5 the word "knowingly," as superfluous and embarrassing.

"*b*. By striking out of sections 3 and 4 the words "solid" and "liquid" respectively, and by substituting, whenever necessary, the word "matter."

III.

"That, in the opinion of this Conference, the question whether the administrative organisation of the Local Government Board could be strengthened and improved by mapping out England and Wales into a few large areas—each area to be under the administration of a staff of inspectors, the whole under the superintendence

of a permanent head of the department, properly assisted, and relieved of secretarial work—is one deserving the attention of her Majesty's Government; and that this Conference is of opinion that it is desirable there should be instituted, without delay, an Inquiry Department in the Local Government Board, for the assistance of local authorities wanting information and applying for it, charged with the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained."

IV.

"That, in the opinion of this Conference, it is expedient that the local authorities should be empowered by the Legislature to make provision for the sanitary inspection of dwellings, upon application being made by the owners thereof; and to grant certificates, on a defined system, according to the perfection of sanitary equipment and fitness for habitation of such dwellings, accompanied by plans of drains, closets, gullies, &c.; and to determine the scale of fees to be paid for such inspection during construction and repair, or otherwise, and also upon delivery to the applicant of the certificate awarded to such dwelling."

V.

"That it is desirable to amend section 252 of the Public Health Act, 1875, so as to extend the time for proceedings to twelve months or two years, or, at least, to six months after the offence is discovered and brought to the notice of the sanitary authorities."

VI.

"That the Council of the Society of Arts be requested to call this Conference together again when they may deem it advisable, especially to consider such advisability when a Government measure shall be brought in to create County Boards, or otherwise to deal with the question of Local Government."

The proceedings of the Conference commenced on Thursday, June 10th, the chair being taken by the Right Hon. James Stansfeld, M.P., at 11 a.m.

The Chairman having announced that he should be compelled to leave, in order to attend a meeting of the Agricultural Commission, opened the proceedings as follows:—Gentlemen, this is the fifth annual Conference in this room on the subject of the health of towns, and of sanitary legislation and administration, over which it has been my privilege to preside. We have discussed a variety of subjects, special, general, technical, legislative, and administrative, and upon this occasion, the Executive of the Conference and the Council of the Society came to the conclusion that it might be advisable to bring together and recapitulate on the programme of to-day some of the conclusions arrived at in one or more of our four previous Conferences, and some subjects which were discussed at those Conferences, although resolutions might not have been arrived at concerning them. The result is the programme you have in your hands, a very large programme, which is divided into certain heads. The first is that of administrative organisation, local and imperial, for sanitary purposes. The second head is, that of practical amendments of sanitary law; and then we come to the third head, which proposes the discussion of a resolution submitted to us by our friend, Mr. Cresswell, a subject and resolution which deserve, and which I am sure will command, your serious interest and attention. Then, fourth, comes "any further suggestions by sanitary authorities" or their representatives on this occasion. The first thing it is my duty to say to you is this, that in putting this programme before you, the Council of the Society and Executive of this Conference desire it to be understood that they are not collectively committed to any of the ideas which might seem to be implied by the formal propositions which are submitted for discussion. All that they have committed themselves to is that these subjects, which have already been discussed in previous Conferences, are worthy our discussion, and in this form in which they have been brought together in their natural and mutual relations. For instance, all these matters which are under the first great head of administrative organisation form part of one great subject, in fact, the greatest subject which we can discuss, with regard to the local government of the country. If you will take the programme in your hands, and carry your eye down to the bottom of the first head of administrative organisation (4 *b*), you will find this suggestion, that the administrative organisation of the Local Government Board should be strengthened, whilst diminishing centralisation and correspondence, amongst other methods, "by instituting an inquiry department for the assistance of local authorities wanting information and applying for it, charged with the investigation of scientific processes, the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained." That was a suggestion of my own, as an ex-president of the Local Government Board, so long ago as our first Conference in 1876, and I refer to it as illustrating the general proposition with which I set out, that these subjects placed before us to-day are subjects which have already been discussed in previous Conferences. With regard to the whole of the rest of this great head of administrative organisation, and to all the propositions contained under that head, they were discussed in the Conferences of 1877 and 1878. Therefore, with regard to the great subject of administrative organisation, local and imperial, which will occupy your attention, I have no doubt, the whole of this morning, the subjects have been already discussed in 1876, 1877, and 1878. Now, the growth of this question from its beginning has been to me, looking back upon it, a subject of very interesting observation. We began in 1876, and then called ourselves a Conference on the Health and Sewage of Towns, and in that year, with the exception of the interlocutory suggestion of the Inquiry Department which I threw out, the whole of the discussion was taken up, and all the resolutions passed, by the Conference, concerned the view we took of the comparative advantages of the dry and wet system of disposing of the sewage of towns. We did not begin with the health of towns, but the health of towns as affected by systems of sewage. That view of the subject-matter, of interest to us, very rapidly enlarged itself, and at the end of the year 1877 we found ourselves face to face with a very different question. In the course of the discussions of those two years, we were continually met by this practical difficulty, raised by practical and scientific men, the difficulty of enforcing the application of the existing sanitary laws, on account of the apathy or ignorance of local bodies, and the anything but disinterested opposition of the owners of property and of the inhabitants of the localities to be affected. I think the great result of our first two years' Conferences was a sense of that difficulty, and at the end of 1877 we were, so to say, fairly abreast of the problem how that difficulty was to be met. Now, scientific men were ready to say, and they said here, and I have often heard it said before, "If people are ignorant, or interested, or apathetic, what you have to do is to change the verb 'may' into the verb 'must,' and to compel those authorities to carry out sanitary laws, which it appears they are not prepared, without compulsion, to carry into effect." That was the suggestion coming from the mind

of men who felt charged with the duty of procuring, as soon as possible, a successful execution of the sanitary laws of this country. But a little reflection showed us—and I do not think there was any scientific man amongst us who did not agree with this conclusion—that, after all, that was not and could not be the remedy; that, practically speaking, that remedy would be impossible. If you were simply to change "may" into "must," and call upon the Imperial department, the Local Government Board, to interfere in every instance of a recalcitrant local authority, and compel them to execute some specific work, or to use their power against some specific recalcitrant individual, the inevitable result would be this, that no man of character or independence would consent to serve on those Local Boards, which would become simply the instruments of the central authority in London. We found that you have, in these matters, to make a choice between two principles. You must either trust to the local authorities and the localities, which seems the only way of getting healthy and intelligent co-operation out of them, or you must simply adopt a system of centralisation, and rule everything from an Imperial department in the metropolis. Now, politically speaking, that is impossible. There is no politician of any shade who, in these days, would attempt to accept or defend such a principle of centralisation as that, and it is practically as impossible as it is politically unacceptable. The country would not accept it; and, therefore, we are bound to seek some other mode. Other suggestions were made, I recollect, in the year 1877. Mr. Cresswell read a paper, which contained certain very practical suggestions. He had noted certain evils of this kind—the existence of certain influences which prevented the efficient application of sanitary laws. He noted the dependence of the occupiers of the smaller cottage property, particularly those whose rates were compounded, on the owners of those properties, and he recognised the dislike of the owners of that small and very profitable cottage property to what is called sanitation. This led him to suggest the ballot, and we found ourselves suddenly, so to say, out of the region of a discussion on what should be the laws of health, or how they should be enforced, and involved in what appears like a political question. That presented itself to Mr. Cresswell's mind as a method of avoiding the undue and unfavourable influence of the owners of small property, and of preserving the independence of the occupiers, who, perhaps, above all others in the towns of the country, are interested in the application of sanitary laws. Then Mr. Cresswell noted another thing. He knew that of which we had ample evidence here ourselves—the want of independence of the local Medical Officer of Health. That is a matter not simply of observation on our part, but of confession and admission on the part of those local medical men themselves. They have over and over again said to us: "You place us in a hopeless and untenable position. You subject us to difficulties and to trials to which we ought not to be subjected; if we endeavour to carry out these sanitary laws, we make ourselves obnoxious to the Local Boards who appoint us, and to the clients who support us in our medical practice; and we want, therefore, some protection and some higher authority, to whom we can refer questions and difficulties of this kind in cases which we can hardly venture to deal with ourselves." With reference to this universally admitted difficulty, the suggestion of Mr. Cresswell was the appointment of County Medical Health Inspectors; that is to say, highly educated competent men, appointed over a large district, sufficiently paid for the whole of their time. That was a suggestion on the lines of the Act which it was my privilege to pass, which did not create County Boards it is true, for the time had not yet come, and therefore it did not create the area of the county for any such purpose, but it enabled sanitary authorities to join in making such appointments, which was intended to pave the way for some such solution as this. At the end of the Conference of 1877, I ventured to suggest that the time was come when we might deal specifically with the subject of the legislation that might be required to meet and overcome all these difficulties, and in making that suggestion, which was followed out in the course of the next year, I gave expression to certain general views and warnings, to which, perhaps, you will allow me to refer again, because I maintain precisely the same opinion now, and it appears to me that they would not be inappropriate on the present occasion. We had been discussing in the Conference the question of how to apply a law which people were unwilling to apply, and the view which I then ventured to take, was this: I said, "The sanitary question, after all, is an educational one. If you take a large view of it, you cannot hope, dealing, as you have to do, with the households of all England, to introduce by compulsion, conditions which shall be favourable to health, unless you enlist in favour of the law of health, the intelligence and goodwill of the local communities, and of the individuals who compose them. The principle I laid down for myself, when I first took part in legislation on this subject was this: I would never yield to the temptation which is often placed before me by scientific men, and medical men especially, to make every law compulsory, saying that certain things shall be done, and bringing down the central authority to do it if the local authority will not. That is a natural view of scientific men to take; but I feel, as a person who has a responsibility with regard to legislation, that I must not think only of what is the most direct route, but of the road which the people will be prepared to follow. I, therefore, laid down this principle that, after all, the problem is educational; that if you have a population who are not educated to believe in sanitary laws, educated by the conditions by which they are surrounded by the existence of local institutions intended for the administration of such laws, that no laws can make the population healthy. You cannot control the habits of the people unless you enlist them in the work, and, therefore, people should not believe too much in arbitrary law imposed by a central authority." Those are my views at the present moment, and I have a very strong conviction that they will be found to be sound. Now, gentlemen, to pass on a little, as I have already remarked, it has been a subject of great interest to me to note the manner in which, from small beginnings, our discussions have enlarged themselves by some kind of spontaneous process until we find that in the end they embrace the whole of the extensive question of the administrative organisation of imperial and local authorities for sanitary and local government purposes. I would first point out to you, in one or two cases, how it came to pass that our views have enlarged and elevated themselves in this way. We discussed the ballot, as a question raised by Mr. Cresswell, from a specific point of view. He wanted it for the protection of the occupiers of small cottage property; but, in discussing it, we speedily found that two questions were involved. First, there was the question of convenience (and convenience is one great argument in favour of the ballot); but having got upon that question of convenience, we naturally went a little further, and said to ourselves, people feel the inconvenience of the multiplicity of local authorities and the multiplicity of elections for local authorities. Can we find a remedy for that; and so we passed on from the notion of the ballot to the notion which you will find on the programme of to-day, of having one day in the country for the election of all local bodies whatsoever. It is an extremely simple and practical proposition. If, on one and the same day throughout the country, you had the election for Town Councillors, Local Boards, Boards of Guardians, and for County Boards, when they exist, you would have a very large decrease of time and cost of all those elec-

tions, to the advantage of those counties and boroughs. But another object of the ballot was to secure, as far as possible, a good governing body in the locality, that is to say, to get on that governing body disinterested and intelligent men, not to trust to the owners of small cottage property, to put laws into practice, which, at their own expense, would compel them to put their cottages into a good sanitary condition. Thereby we found ourselves almost imperceptibly led on to consider the whole of the great constructive arrangements raised under the head of administration and organisation on the programme of to-day; that is to say, the best area for local government, the best method of election, and the functions which ought to be imposed and conferred upon bodies thus to be formed. Now, there are certain propositions here which I have enumerated, and which will be matter for discussion again, to which I should like to refer for a moment. The first is this. I do not say this has been omitted, but I ask you to allow me to insert it, under the head of "sanitary districts." The first proposition I would like to lay down is this, that the unit of area for local government purposes, that is to say, the smallest area, should be as large as may be convenient and practicable. I think we most of us arrived at that conclusion on former occasions. If it is unadvisable that Local Boards should consist, to any large extent, of the owners of that small cottage property which most needs improvement, it is also unadvisable that very small areas for local government purposes, with sparse population, should exist, because then you have conditions under which you cannot have an independent and intelligent local governing body. Now, the old Local Government Acts put it within the power of local authorities voluntarily to adopt a system of local government; and under these conditions were created, particularly in the manufacturing districts of Lancashire and the West Riding of Yorkshire, and some of the other northern counties, a large number of very small local government districts. That we found to be a great evil, because you cannot possibly have an independent local governing body in a small district of 300 or 400 inhabitants; and some of them are even smaller than that. The first proposition, then, is the desirability of having a unit of area as large as conveniently may be. You must have regard to the character of the population, and you must in one place expect a smaller unit of area than in another, but I think the aim ought to be, not to multiply those small areas; and in the Local Government Act, which it was my privilege to pass, I introduced a clause, which is still law, which practically has kept down the multiplication of these small areas. Then the next proposition we come to, which has been discussed here already, is this: the advisability of making the governing body of this unit of area the governing body for all local purposes for which that area is fit. That may sound an abstract proposition, but I hold it to be a very practical proposition. I do not say you can do it all at once, but I say that is the idea that legislators ought to have in their minds, and towards which we ought to advance as well as we can. The object is this. There are many people, men of education and leisure, who do not care to go on a Local Board simply for the purpose of discussing questions of drainage or the foundations of houses, but they may take an interest in other matters which are the subject of local government; and I may illustrate what I say by reference to the subject of education. Where education is part of the local government of a particular community in a particular area, you interest a class of people whom you would not otherwise interest in the local government of that area. I think, therefore, that principle ought to recommend itself to our minds for the sake, first of all of simplicity; secondly, for the sake of getting the best men to go on the local governing body. Having got so far, you find yourselves face to face with the question, What are you to do with the functions which require a larger area? For instance, you cannot advisedly deal with roads on the smallest areas. Local Boards do that now, but it is not advisable; and certainly they could not deal with the conservancy of rivers. What are you to do with regard to functions which require to be exercised by the governing body of a larger area than the unit of area for ordinary purposes. There is a very simple view to take, but I think its adoption in legislation will prevent the recurrence of the enormous amount of cross-purposes and confusion which has existed in past times, and that is, that in constituting the larger area, you should always make it the aggregate of smaller ones; you should never allow lines to cross. That is a very simple proposition, and you will find that there is no practical difficulty in carrying it out. That really brings you to the great subject with which we have headed our programme to-day—County Boards and county administration—the aggregate of units, say within a county united together for county purposes, making a county area, of which the County Board will be the governing body in the future. With regard to the County Board, I think that Board is needed to manage the roads of a county, to manage the bridges, and we know it is needed to manage the county lunatic asylums, and, not at all improbably in the future, the county workhouses. I do not lay that down as an absolute proposition, but I feel it to be a thing particularly worthy of consideration, whether, if you have a county area and County Board, you may not, at some future time, sever the management of the whole in and out-door relief, and classify your workhouses, and put them under a committee of the County Board. That, from an administrative point of view, every Poor-law reformer would tell you would be a great advantage indeed. You want them for the conservancy and prevention of pollution of rivers; and amongst other things incidentally that through the County Board you would find yourself able to do, would be to secure the appointment of those highly paid and really independent Medical Officers of Health, the necessity for whose appointment Mr. Cresswell pointed out in the paper to which I have referred. Having got thus far, a new view seems to me to dawn on our minds, and I think we have felt it already. I have been endeavouring to trace to you the process by which I think our minds have been operating, till we have come by these steps up to the idea of the County Board. Now, the moment you accept the notion of the creation of a County Board, the crown of the edifice of local self-government, you find the whole character of the problem changed and magnified in your own eyes, a higher status is given to local government, a healthier and more vigorous life; the county, you would find, would have an individuality of its own, a collective individuality, which would lend support and strength to every one of the minor subordinate local governing bodies within the area of the county. The whole system would be strengthened, and pervaded by a higher tone; and, to use an expression which I have used before, the centre of gravity of the combined system of Imperial and local self-government would be distinctly changed, and the change would be nearer to the principle of local self-government than that of Imperial centralisation. On the other side, the nature of Imperial supervision would immediately be affected, and most beneficially altered in the minds and in the practice of Imperial administrators, by the fact of the institution of the County Board; and the most dangerous tendency to centralisation would receive its only possible check. An Imperial department, dealing only with small local bodies who could not be trusted to carry out efficiently a law which it is its duty, as an Imperial Department, to see carried out, must centralise and continually interfere. The only remedy for that is the existence, or creation, of larger bodies, such as County Boards. It seems to me that the

existence of County Boards would tend to alter the methods of business of the Local Governing Board and its relations with the local governing bodies of the country. That is one of the subjects before us to-day, and that change would be operative on the institution of County Boards. But, in my opinion, that change could be to a large extent operated and effected immediately, and ought to be effected. I have a very distinct opinion as to the method of organisation and administration of the business of the Local Government Board. My conceptions were founded on anti-centralising notions, and on the idea that you must deal with men through men—that you had better do as little as you can through correspondence, and that you had better respect, as far as you can, the individuality and independence of those with whom you have to deal, and whom, occasionally, you have to call to account. That is a subject which you will also discuss to-day, and upon which I hope you may find it within your power to come to some conclusion. Lastly, not to detain you too long, there are still two wider aspects of this question, upon which I must say a final word. The first is the educational aspect, to which I have referred already. We must have an educated co-operation of individuals, as well as of local governing bodies, if we are permanently to have a thoroughly well administered and efficiently applied sanitary law. The law of health should form part of the education of the children of the people. If you have, in some future time, the local governing body undertaking, as one of the normal functions of local government, the education of the children of the locality, it will follow, simply and easily, as a kind of logical sequence, that they will find it their duty to teach the simple law of health to the children of the people. And in another sense, the educational aspect of this question is of interest. In the meantime, self-governing institutions are themselves an education; they not only train people to self-government—which, from a political point of view, is of the highest consequence—but they turn them to an intelligent and active interest in the subject-matters with which these local governments have to deal. If you could rule everything, *ex cathedra*, from the centre, the places in the country and inhabitants having no concern in it, and having only to submit to the orders you sent out, would remain unintelligent, and all your sanitation would fail; because, whatever you did outside the house, they would contrive to have constant unsanitary conditions within their four walls. But having local institutions of a representative character, we should respect their independence; and, with regard to them, you must have some patience whilst they are learning their own task; they tend to educate the people whilst they are themselves learning the duties which they have to perform. The other aspect of the question, and a very wide aspect, is the political. There is a growing conviction in the minds of men of all political parties and sections that the duties of the Imperial Parliament must be lightened. In one sense, Home Rule is coming to be a question for England and Scotland, as well as for Ireland itself. Now, that is not an aspect of the question which directly concerns us as sanitary reformers. I simply note, for our own reflection, that we may keep it in our minds and in our consciousness, that these are considerations which, in all probability, will lead to larger schemes of local government in connection with the creation of County Boards in the hands of the present administration than they would necessarily have led to if they were simply considering the question from our point of view; and all that I have to say upon it is this, that should it be the case—I am not very sanguine as to the time, and many other questions press on the Government of the day, but when the subject does come to be dealt with by them, I think we, as sanitary reformers, may rest perfectly satisfied in this conviction and consciousness, that the wider the scheme, and the more elevated the point of view, whatever political or other motives may induce such enlargement—the wider the scheme of local government reform which may be passed by this or any succeeding administration, the more likely is it to be in accordance with our principles and objects as sanitary reformers. I have now detained you quite long enough with these opening remarks, and I must beg you now to allow me to go away for a short time.

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It is no less reasonable and desirable that, if the division into urban' and 'rural' is to be maintained, they should ake the same position on the future Boards for the anitary management of urban districts. We believe hat the constitution, mode of election, and duties of Local Boards, whether for urban, suburban, or rural districts, should be uniform throughout the provinces of England. There is no question of graver import or requiring greater attention than that of the compulsory acquirement of land by local authorities for certain purposes essential to the improvement of the public health. In what manner and on what conditions local authorities—whether those of large towns or those which might act over larger areas—should be empowered to provide sites for dwellings of labourers and artisans where densely populated parts of towns have been or may be demolished for purposes of public health (*e.g.*, under Mr. Torrens's Act)—whether such authorities should be empowered to acquire land for burial-grounds and mortuaries, for hospitals for fevers and other pestilences, for disinfecting establishments, for public slaughter-houses, for recreation-grounds, as well as for water-supply and for sewage utilisation—these and other like questions require the most careful consideration. For all these purposes and many others, involving both appeal and compulsion, an intermediate authority to consider and report on applications of local authorities would be invaluable. And, moreover, we cannot too strongly urge on the Legislature the necessity of limiting the powers and functions of the central authority within the narrowest bounds consistent with effective action. Not only should local impatience of interference be considered and obviated by constitutional means, but a suitable authority, intermediate between the local and central, should be constituted in every county or sufficiently large area, as likely to be more cognisant of the wants and circumstances of every smaller district, and better able to judge of minute details inseparable from the daily working of Local Boards, than a Government inspector." The last important reason which was adduced by the committee for wider administrative areas was that they would supply a superior machinery for the appointment of scientific officers, whether medical or engineering, of high and special qualifications. The committee then proceeded to argue with great force against the illogical and unsatisfactory method in which the Commission proposed to provide for the appointment of Health Officers (a policy since carried out with aggravated evils by the Local Government Board), and insisted upon the importance of the duties of such officers. They adopted the opinion of the General Board of Health that "the occupation of a Medical Officer of Health will not usually be inconsistent with his devoting a portion of his time to certain other professional engagements; but, where possible, it will be well to debar him from the private practice of his profession; first, because the claims of such practice would be constantly adverse to those of his public appointment, the duties of which (especially at times of epidemic disease, when his official activity would be most needed) private practice could scarcely fail to interrupt and embarrass; secondly, because the personal relations of private practice might render it difficult for him to fulfil with impartiality his frequent functions of complainant; and thirdly, because, with a view to the cordial goodwill and co-operation of his medical brethren, it is of paramount importance that the Officer of Health should not be their rival in practice, and that his opportunities of admonitory intercourse with sick families should not even be liable to abuse for the purposes of professional competition." 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It cannot be doubted that a grave difficulty in the way of the complete registration of infectious disease throughout the country is the fact that in the majority of sanitary districts, as at present constituted, the Medical Officer of Health, to whom all notifications of the existence of infectious cases must of necessity be referred, is a practising physician as dependent upon local patients as those practitioners who would have to report their cases to him. The reluctance of these latter to assent to such an officer becoming acquainted with the nature and extent of their practice can easily be imagined; and it would seem worthy of consideration whether the compulsory appointment of independent Medical Officers of Health, should not proceed *pari passu* with the compulsory registration of infectious sickness. On this point the Joint Committee reported:—"While we perceive with satisfaction that the Commission recommends the registration of sickness, we doubt whether the method thereof should be wholly left, as proposed, to the Registrar-General, without insisting upon the necessity of considering in the first place the sanitary needs of the localities from which the returns are collected, and in which they ought to be promptly applied to local sanitary action. It is in regard of this function that a skilled and comparatively independent Officer of Health becomes indispensable. A proper machinery for the local revision of mortuary and sickness returns, by a skilled and independent officer, would be provided by vesting the appointment of the chief Health Officers, debarred from private practice, in intermediate authorities; and to county Justices, it may be observed, the Legislature has committed the appointment of public analysts." 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sidered to be beyond the scope of party, and which had alike received the sanction of men sitting on the Government and Opposition sides of the House—notwithstanding, as he was fully persuaded, that the minds there represented were made up on the question—they were still in the same position that they were in 1871—projecting, suggesting, and endeavouring to inculcate, but without having had the effect of altering, or in the slightest degree improving the law. The time, therefore, was come when, instead of starting or endeavouring to ventilate new ideas, they should draw up and formulate a series of conclusions which should go forward to the public once for all as the axioms of 1880, which it would never be necessary for them to re-open or re-discuss, but which would be accepted as a point of departure for future sanitary conferences. That was the object of that Conference. It was thought better to ascertain their position—to lay down the lines for future progress, and expedient to review that which they had already achieved during the last five years, and then to go forward, as they might in future hope to do, upon those lines. They were not asked to pass a resolution in favour of County Boards; and it would be turning back the wheel of time at least ten years to do so. In fact, the Conference of 1878 passed a resolution—to which attention was called in the programme—which expressed in the strongest possible way the unanimous opinion of the then Conferenee. Although that was only two years ago, they should never hark back to a period which, in the annals of sanitary progress, he might call a century; for it must be recollected that sanitary science was the creation of the last 25 years, and that the advances made in each year might represent almost a century of progress in other matters. What they were asked to do was to express an opinion as to what should be the constitution, the objects, and the method of the County Boards; and he would call attention to the paragraph marked A, "That such County Boards, or combinations of them, should, *inter alia*, be charged with the conservation of rivers." He was not aware that that idea had ever been brought before that Conference. They had heard a great deal about Water-shed Boards, and, at a Conference last year, they had a very important discussion on National Water Supply, and cognate questions, and it was suggested, in admirable papers, that there should be Conservancy Boards and Water-shed Boards, or organisations of that sort, for the purpose of the prevention of floods, and the storage of water. A Bill was brought into the House of Lords, and passed through a certain stage, which proposed to map out the country into Conservancy Boards for that purpose, but, for reasons he need not further discuss, that proposition came to an untimely end, and they heard nothing more of it. Without touching on political matters, it was common knowledge that there was now a new Parliament; and it was with reference to that new Parliament that the Executive Committee determined to draw up this programme, so that by resolutions based upon it they should be in a position to inform the mind of Parliament, to strengthen the influence of men like Mr. Stansfeld, who, they fondly hoped, would occupy a position in that Parliament which would enable him to carry into effect many of those admirable suggestions which he had made in that room. He might say in his absence what he should perhaps have hesitated to say in his presence, that he considered it a most fortunate thing for the country that their right hon. Chairman was at that particular moment not a member of the Government; for had he been, his mind would have been cribbed, cabined, and confined, his utterances would have been to some extent qualified, and he would have felt himself constrained, probably, not to take the position he occupied so well, of Chairman, and thus they would have lost the opportunity of hearing one of the most admirable summaries and expositions of the programme that could have been made. The fact that he occupied a high position in the House of Commons, and was listened to with the greatest possible respect on all these subjects, was fortunate in every sense; and by arming him with the opinion of the Conference, he would be able to go to the House of Commons and say to the representatives of the nation, "These are no crude theories of visionaries or speculative philosophers; they are the recorded opinions of practical experienced men, who assemble periodically in the metropolis for the purpose of discussion and information, and who are typical representatives of the public opinion of the country." In arming Mr. Stansfeld with the power, they were practically taking the very best course to force upon the Legislature those amendments and reforms which might be suggested. As he had said, they had not yet obtained County Boards, but he thought they were on the eve of doing so, because there were many minds in the present Parliament which might be for this purpose described as virgin minds, impressionable, susceptible, impartial minds unfettered, unclouded by prejudice, or narrow views. They had, therefore, arrived at that particular crisis in the national and Parliamentary history, when they should do what the Duke of Wellington said was the only thing to be done at the battle of Waterloo, at two o'clock, when he was pressed by the French, namely, "keep pegging away." If they passed those resolutions, or any of them, in the form suggested, they would achieve the object they all had in view, namely, recording their own opinions, influencing public opinion, and through public opinion, and that most valuable adjunct to public opinion, the daily Press, they would inform the mind of Parliament, and relieve the champions of sanitary progress of many of the difficulties, and remove many of the obstacles which had hitherto impeded all legislation. It was with reference to that mode of action that he wished the Conference to address themselves to their task. If any gentleman objected to handing over to the County Boards that most important duty, the conservation of rivers, let him say so, and let it be the subject of discussion; but, on the other hand, if no one objected to it, they might easily draw up a resolution which would affirm the suggestion here made. If the Conference was of opinion that it was well within the limits and scope of a County Board that they should be charged with the conservation of rivers, then they arrived naturally at the second suggestion, that they should be empowered to put the Rivers Pollution Act in force. After the exhaustive and admirable exposition of the programme by the Chairman, he should content himself with calling attention to these suggestions; and he was satisfied of one thing, that whatever might be the result of the legislation of the last 20 years, however excellent the statutes might be, there was something yet wanting, and that was the will and the power to carry them into execution. If you armed a County Board with the power to put the Rivers Pollution Act into force, subject to certain modification to which attention would be called tomorrow, he thought it would be doing good. It was an excellent statute, as it was at first framed, but the fact was, it had been emasculated; and the attention of the Conference some years ago was called to the grave defects in the Act by his friend Mr. Willis Bund. The difficulty was to put the Act in force. It could only be done with the consent of the Imperial authority, and at the same time with the consent of the Local Sanitary Board, who acted as the intermediary between the aggrieved individuals suffering from the pollution, and the Local Government Board. That at once conflicted with the principle which had been advocated again and again as essential, not only to political welfare, but to the progress of sanitary reform, the decentralisation of power. Their Chairman showed that in 1877 they had made up their minds on that point; and inasmuch as the Act of 1876 reiterated, in its most

offensive form, that evil of which so much complaint had been made, namely, the handing over to the Imperial authority in Whitehall powers which should have been long ago delegated to the local authorities, they were only carrying out the opinion of scientific men by this suggestion. If, therefore, they would give to the County Board the power and the right, at the suggestion of an aggrieved person, or of its own motion, to put the Act in force, and send men to that County Board who were true representatives of the public opinion of the county, they would have a Board which was a representative authority, and empowered to do that which they believed to be necessary for the prosperity of the community. Next came the question of the cost of proceeding by means of a county rate. One of the greatest defects in the Rivers Pollution Act was, that it did not provide in any satisfactory way for the payment of the costs. Practically, it had never been put into application at all. In one or two instances it had been attempted to put it into operation, but the expense was enormous. Another thing was, that it was not worth anybody's while individually to put it into operation. They all lamented the pollution of rivers; but some were deterred by social prejudice, or regard for their own interests, some by the fear of encountering public odium, while others thought they would incur heavy expense. The other difficulties arising from the method prescribed by the Act, added to these, had rendered it practically inoperative. The next and most important head was, that to which attention had already been called by the Chairman, that such Boards should have the power to appoint Health Superintendents in each country. An opinion had been already expressed at the Conference in 1878 on that point, and it was not necessary to re-argue it. Of one thing there could be no doubt, that practically there was no medical inspection or superintendence in any county. It was true that in Warwick, and several other counties, men of high position had been appointed, with good salaries, by a union of particular districts, upon application to the Local Government Board for assistance by way of subsidy; and in consideration of their paying one-half the salary, the Local Government Board claimed the right of preventing and vetoing, or sanctioning and confirming, the election of a particular officer. That was the only approach he knew to what they all desired, namely, that in order to have complete execution of sanitary laws in any county, they must give the local medical officers the advantage of an officer superior to themselves in power, and in the extent and scope of his jurisdiction, appointed by an independent body, and paid out of the county-rate, who would be freed from all the social relations which existed, and ever must exist, between a physician and his patients, and at the same time remunerated upon a scale worthy of the talents which he must necessarily possess, rendering him entirely independent of all those well-known influences which tend to cripple the energy of the most able and energetic men everywhere.

Mr. Gould (Kingston) said, as the County Board had been so much referred to, he should like to ask some explanation as to the constitution of it. Would it be by direct representation or not? Mr. Cresswell said they did not touch the political question; they left that for Parliament to settle.

Mr. Adolphe Smith desired to bring under the notice of the Conference some special experience he had been able to acquire with regard to methods of inspection. Mr. Cresswell had properly remarked that the Rivers Pollution Act was a dead letter. Now, in the first paragraph of the programme, Article 4, the question of local government inspection was referred to, and he wished to point out what was done in Paris by the French authorities to insure efficient inspection, and the carrying out of sanitary laws. His opinion was that if they created these County Boards, which would be a kind of local centralisation, they would not avoid altogether the danger of imperfect, insufficient, and incorrect sanitary reports, unless there were some special means of checking these reports; and, therefore, he thought it might be useful to state what was done in Paris to insure that result. The system, in a few words, was this. With regard to unwholesome industries, the inspector was nominated by the Prefect of Police, and it was generally arranged that he did not live in, and had no connection with, the district he had to inspect. Thus, if he had to inspect the north-east of the town, he would probably have his home and connections in the south-east. He received from his central authority an order to inspect such and such a factory or river, but when he went to that factory or river he did not know whether he was going to write an original report upon it, or check the report which some one else had made before him, and when he concluded it he did not know whether another inspector would not be sent to follow his footsteps. He simply went to the place and recorded what he saw, without knowing what check would be exercised upon him. Hence these men dare not commit an inaccuracy, and no amount of local influence could persuade them to fail noticing any abuse. In the reform now proposed, the inspector working for a District Board might fail in his duty if not controlled by the central County Board, but he did submit to the meeting that, for the efficient carrying out of sanitary laws, particularly when the inspectors and officials were under local influence, and were chosen from the locality, and could not but be slightly partial towards certain individuals in that locality, one of the advantages of centralisation would be to exercise some sort of check over the inspectors.

Dr. Bond (Gloucester) asked if the Executive Committee were prepared with any resolutions to formulate the views which had been laid down in the programme. At a previous Conference he had drawn attention to the desirability of this being done, which had prevented a great deal of desultory discussion, and greatly facilitated those who were present coming to a speedy conclusion, and getting through the business in a more rapid and satisfactory way. If the Executive were prepared with such resolutions, it would be desirable to bring them forward.

The Chairman said the committee had not prepared any distinct resolutions, as they thought it would be better to allow such to arise naturally out of the discussion.

Dr. Bond asked if it were proposed that the resolutions should be deferred to the end of the meeting, because he thought that course was objectionable.

Mr. Alcock (Sunderland) suggested that they might take the resolutions read out by Mr. Hart, as they contained a very full definition of what probably the Conference would desire to pass, and it would be much better to have something definite before them than for each speaker to be wandering over the whole subject. He would beg leave to propose the first one:—"That the existing division of the country into urban and rural districts does not enable local authorities to fulfil their obligations in the most effective manner." He should prefer, however, to say, "That the existing division of the country of urban and rural districts," because he thought it would be clearer. There could hardly be two opinions that the present system was unsatisfactory, although there might be a difference of opinion whether the same law should apply in its entirety to urban and rural districts. He agreed with Mr. Chadwick, that it would be of little use passing resolutions there, unless they could carry the opinion of the local districts with them, but virtually that had been done to a great extent. Within the last ten years they had made considerable progress. In 1872, the country was mapped

out into urban and rural districts, and there was no portion which was not made into a sanitary district without a specific sanitary authority having charge of it. In so doing, the Government of the day adopted what he believed would be found to be a very proper commencing unit, namely, the Union. Outside municipal boroughs, the Union was adopted as the Local Government area, and the different Boards of Guardians had been formed, in great measure, into the local governing bodies. The tendency ought to be to make them governing bodies for all local government purposes, and the result of that had been this, that the mind of the country had been educated to see that the unit of area ought to be extended from the parish, which used to be the unit. Since Boards of Guardians had been empowered to carry out these various mattters, there had been Conferences held locally, at which these matters had been discussed. The country was almost entirely divided into districts in which Poor-law Conferences were annually held, and at which the whole subject of local government was brought forward. He had the honour of belonging to the Poor-law Conference for the four northern counties, which met every year, and took up these various subjects, and had passed a resolution on this very subject of County Boards. These Conferences had furthered the question very considerably, and convinced the public mind that there ought to be some representative authority for county purposes. They had also, many of them, passed resolutions that the Union was the best unit of area. Bearing in mind that the different parts of the country were represented by delegates who had opportunities of considering the same question from different points of view, he thought they were now in a position to adopt resolutions which might probably have a considerable effect, and he would, therefore, move the first resolution, with the slight alteration he had mentioned.

The Chairman said he thought these resolutions were very good, but they went rather too much into detail, and suggested they should rather adopt the first paragraph of the programme as a resolution.

Mr. Alcock said there might be considerable difference of opinion on a resolution like that. It went quite as much into detail, and mentioned specific objects, whereas these resolutions of Mr. Hart's suggested simply that, so far as practicable, all the purposes of local government should be dealt with by the County Board. That was quite sufficiently definite without going into specific questions of pollution of rivers, and other like questions.

Mr. Gould suggested that they should proceed as the programme stood, first asserting the general principle, and then taking up subjects A and B.

Dr. Robinson (Dover) submitted the following resolution:—"That, in the opinion of this Conference, it is desirable that County Boards should be established throughout the country, having, amongst other functions, the duty of being charged with the administration of existing Acts of Parliament with relation to the public health, the conservation of rivers, the management of roads, and education."

Dr. Bond said this discussion showed the inexpediency of not having resolutions drawn up. He was willing to second Dr. Robinson's proposition, but he must confess it introduced a subject entirely novel, namely, that of education, which really required a good deal of consideration. Before endorsing that, he should like to see how it was going to work.

The Right Hon. J. Stansfeld returned, and resumed the Chair.

Mr. Alcock said to include the conservation of rivers was a thing open to considerable doubt, because you could not confine a river to a county. He thought it would be much better to adopt the words which Mr. Hart told them had been very carefully considered, and say that the division ought to be for sanitary and other purposes of local government, which included everything as far as practicable to put into the hands of a County Board. A Conference like that could not go into questions of detail, such as education, and conservation of rivers, and it would be far better to adopt general words, which included all the purposes of local government, so far as those were practicable to be entrusted to the care of a County Board. He would move that those words be substituted for the specific subjects mentioned in the resolution.

The Chairman said if any serious doubt or difference of opinion existed, it would be better to leave out a specific reference to the conservancy of rivers, but he did not go with the criticism he had just heard. He objected to the multiplication of areas and governing bodies, and to the crossing of areas, and to the clashing of jurisdictions. It was of great importance to have a system applying to the whole country for all purposes, and he did not think there would be any difficulty in dealing with the question of the conservancy of rivers through County Boards. It was true that you ought to have the conservancy of the whole course of a river in the hands of one Board, and where that was not within one county, the case would be met by two or more neighbouring County Boards forming a joint committee, for the purpose of looking after the rivers within their respective areas. He strongly urged the Conference to bear in mind that it was desirable, in drawing a perfect system of local governing authority for these administrative areas, not to create purely scientific areas, but to accept those local government areas which were a part of the system as a whole. It would not be necessary that the whole area of two or three counties should form an area for conservation of a particular river. All that would be required would be that the authority should be an authority constituted by those various County Boards.

Mr. Alcock said he had not opposed the question of conservancy being entrusted to County Boards; all he said was that it was not desirable to specify minutely any particular subject of local government. The desire was, so far as pracicable, to place all local government in the hands of the County Board, and he proposed to put that into so many words, instead of specifying each subject.

Dr. Robinson said the substance of his resolution was, that this Conference is of opinion that County Boards should be established, and he desired to affirm that principle, and that, among other functions they should have to perform, should be those for the purpose of administering the existing laws with relation to health, the conservancy of rivers, and the management of roads. He had no objection to omit the word "education."

The Chairman asked if he had any objection to adopting the more general formula.

Dr. Robinson said no; he would omit the specific words.

Dr. Bond said the desirability of appointing County Boards had been generally recognised. What they desired to do was to call attention to the desirability, in legislating on the subject. of giving those Boards certain powers with reference to local administration. If they did that, they did practically all they could. He had ventured to draft a resolution, which he thought met that view, namely, "That the attention of her Majesty's Government be respectfully invited to the desirability, in any legislation for the appointment of County Boards, of giving to such Boards the largest powers, for the purpose of consolidating, har-

monising, and economising administration in all matters of local government within their districts." If they could only succeed in drawing the attention of the Government to that aspect of the question, they would have done all they really wanted. The Government would take the trouble to acquaint itself with the directions in which that consolidation could be effected. There was now a great deal of conflict of action which might be prevented, if some legal organisation, such as a County Board, existed for the purpose. He would really press on the Conference the desirability of giving the resolution the largest possible scope.

Mr. Alcock suggested they should leave it to the Chairman to draft a resolution, and submit it at a later period. They had already resolved, on a previous occasion, that County Boards were desirable, and he thought they might go further this time, and urge upon the Government the necessity at the earliest possible moment of introducing and passing a Bill for the establishment of County Boards.

The Mayor of Exeter, as the representative of a large Local Board, wished to inquire how far it was intended to interfere with the present Local Boards—whether the County Boards would absorb the smaller or all the Local Boards.

The Chairman said he should say certainly not. He could not say what was the mind of every member of the Conference on the subject, but he believed that if County Boards were established, and they were set to work with enough to do to begin with, the tendency of the future would be that they would aggregate to themselves some functions now exercised by inferior jurisdictions. But that would be a work of time. He did not think it was ever intended that any County Board should take the whole local government of the county, except the local government of the towns, into their hands, for that would be centralisation under another aspect. He was strongly disposed to discourage the multiplication of small local government areas, but he saw no reason why those at present existing should not continue. There would be plenty for County Boards to do without interfering with them. Certain relations might become established between the subordinate Board and the County Board, and it might end in the County Board exercising some of the supervising functions now exercised by the Local Government Board itself; but all these things would be matter of growth.

Mr. Day (Reading) said that question did not come within the scope of the Conference, but lay within the jurisdiction of Parliament.

The Conference then adjourned for luncheon. On resuming,

The Chairman said the resolution was now being written out, and while that was being done, he would make one remark in reference to a suggestion made that morning, that it would have been well if the Executive had prepared a series of resolutions. After consideration, they did not adopt that course, because they thought it was more respectful and fairer to the Conference to put a programme before it, and let the resolutions be the outcome of their own discussion, and he hoped the result would show they had been right. The resolution would be partly general and partly specific. Of course, they might omit the latter part, but he should recommend them to adopt it. He desired, besides the statement of the importance of instituting County Boards with the least possible delay, and constructing them on the largest possible lines, that they should direct pointed attention to one particular subject, the question of the conservancy and prevention of pollution of rivers. There was a scientific conception that you ought to have for the conservancy of rivers water-shed authorities, and it was a true scientific idea, because if you wanted to deal with a river you could do it best by an authority dealing with it throughout its whole course But when scientific men proposed a water-shed authority, they should recollect that there were two sides to the question. They had not only to think what was the best area for this particular purpose, but also what bearing the institution of authorities on that particular area would have on the whole system of local government in the country. There could be no greater object than to build up the most perfect system of local government. If, therefore, they should constitute the water-shed authority through the medium of an existing or to be constituted local authority, that was clearly an advantage. Practically, there were two courses. Parliament might divide the country into certain water-shed districts, and might create entirely new authorities in each of them for the conservancy of rivers within that water-shed, or might say it would refer this matter to the County Boards, giving them power to unite for the purpose of constituting amongst themselves the water-shed authorities of the future. That would be going on the lines of the Act for which he was responsible, the Local Government Act. When that Act was passed, he could not form County Boards, but he endeavoured to lead the way to it, by introducing clauses which facilitated the union of urban or rural sanitary authorities for certain purposes, for which a larger area was preferable to the area of those particular authorities; and under that clause, and the one regulating the appointment of Medical Officers of Health, there were at present a certain number who were practically appointed for the county at large. Extending that idea, having constituted County Boards, if you got a function for which the area of the county was not large enough, then amalgamating the counties, or giving the County Boards the power of combining from amongst themselves, you got the new authority for the new and larger area. His view would be, that County Boards, or combinations of them, should, in preference to newly created authorities, be charged with the conservancy of rivers and so forth. All he asked them to do was to assert the importance and advantage of respecting the system of local government, which they hoped to complete by the creation of the County Board, and to create a new and larger water-shed authority, with some kind of regard to that system. With that view he had prepared the following resolution :—

"This Conference confirms the resolution passed by the Conference of 1878, in favour of the constitution of County Boards to conduct the ordinary administrative and financial business of the county.

"This Conference is further of opinion that such representative County Boards should be instituted with the least possible delay, and that the functions entrusted to them, and the powers conferred upon them, should be wide and full, and conceived in the view of enlarging, elevating, and re-invigorating the principle of local self-government in this country; and, further, it is the opinion of this Conference that such County Boards, or combinations of them, in preference to newly-constituted authorities, should be charged with the conservancy of rivers, including the prevention of floods, the storage of water, and the preservation of rivers from pollution. And, lastly, that such County Boards should also be charged with the appointment of County Health Superintendents in each county."

Professor Way, as a member of the first Rivers Pollution Commission, said he could not fail to be struck with the difficulty and mischief attached to the subdivided administration of rivers. Nothing could be more palpable than that a river should not, by any possibility, be brought under divided administration. And, therefore, he confessed, when the proposition to make County Boards, which could not by any possibility have the same areas as the rivers and their tributaries, was put forward, it struck him that there would be a conflict of administration after a time, and that the rivers could not be properly arranged under that system; but directly the Chairman proposed what he might call

the federation of those Boards for that purpose, he saw the difficulty was at an end, and the proposal to make the specific recommendation that combinations of those Boards within the water-shed area should be the controlling power for the rivers, met any difficulty that might be raised. He, therefore, should have much pleasure in seconding the resolution.

Dr. Bond said, as he had made the remark to which the Chairman had just referred, as to the desirability of some specific resolution being put before the meeting, he wished to say now that he felt they were very much indebted to the Chairman for having drafted the resolution in the form in which it was now put. It was something tangible, and expressed, he believed, the general opinion of the meeting. He did not take any objection to it, but he would point out one aspect which might, to a certain extent, weaken its influence, namely, the specific reference made to the powers which County Boards should exercise in dealing with the jurisdiction of rivers, which might to some minds suggest the fact that that was, if not the only, at any rate one of the most important, subjects with which County Boards would deal. He need not point out that there were other matters connected with the relation of sanitary authorities to one another which very much required the intervention of some such body as a County Board, for the simple reason that they were not discharged at all by the Local Government Board, or not in such a way as to give satisfaction. There was the whole question of the co-ordination and relation of authorities to one another, with reference to drainage and the powers of outlet which one sanitary authority could be called upon to give another, questions with regard to the mutual rateability of areas for drainage purposes, questions of the establishment of infectious hospitals, and numerous other points on which it seemed to him that a County Board could intervene with very great advantage; and he only suggested that, not with a view of leading to the exclusion of any reference to the rivers, but simply with a view of getting the meeting to consider whether it was desirable to refer to the question of conservancy, without, at any rate, coupling with it a reference to drainage and other matters, which might indicate to anyone who perused the resolution that that was not by any means the only or most important question to be considered. On a question of public health, he did not think it was the most important, for he thought there was a far larger amount of life sacrificed unnecessarily, for want of proper organisation in other ways, than arose from the pollution of rivers. He hoped they would pass a resolution which the Chairman would be able to use in bringing pressure to bear on the Government.

Professor Way hoped that, in spite of what had been said, the question of rivers conservancy would be retained. The sole object of introducing the mention of that was that it was one which had to be done in some kind of combination; that was the only reason why it was specifically mentioned. All other questions, such as hospitals and health generally, were questions which would come individually under the County Boards.

Mr. Owen (Exeter) said there was a term used in the resolution of which he should be glad to have some explanation. It proposed that certain powers should be given to County Boards, in preference to newly-constituted authorities. What did that term mean?

The Chairman said it meant this—the question of the conservancy of rivers had been inquired into, and the recognised opinion was that the only true remedy for the inconveniences and evils now existing lay in the constitution of water-shed authorities; but it had not occurred to those who investigated the question to say anything about the constitution of these water-shed authorities, except that they should be constituted with regard to certain water-shed areas. What he desired the Conference to lay down was, that whilst fixing upon the area purely with a view to the exigencies of the case, they had better construct the governing body through the County Boards, so as not to introduce confusion. With regard to Dr. Bond's suggestion, what Professor Way said was quite true. If it were worth while, they might say, that such County Boards, or combinations of them, in preference to newly-constituted authorities, should be charged with any functions needing an area more extensive than the county. The only object of specifying the rivers preservation was, that that was a matter which required an authority extending over two or more counties, or parts of counties; and if there were any other functions which it was worth while to mention in that connection, it might come in there; but he did not know that there were. As to the functions which the County Board should take upon itself within the county, it was met by the large general words which were used concerning the importance of enlarging, elevating, and reinvigorating the principle of local self-government.

Dr. Bartlett said, when the Chairman observed that the water-shed area might contain two or possibly more county authorities, or portions of them, he conceived that there a dividing line might occur, which was so strongly spoken against in the opening address. If, for instance, the water-shed areas were not entirely contained in two or more counties, or if the counties were not to be made integral portions of the water-shed area, all those difficulties arose, where, in one portion of the county authorities, the water-shed authority was co-terminous, and another where it was not. There, again, came in the question of rating in one district and rating in another; hence the fundamental principle on which to act would be still to map out what the necessary water-shed areas were, and then, from that amount of geographical position so ascertained, to be able to subdivide it into units of counties. That should be so done as to give the largest possible area compatible with proper regulation; but he apprehended considerable difficulty, in the first place, if the water-shed was not exactly equal to so many county areas. If there were any overlapping portions of counties which were within one water-shed, while another was within another, there would be retained that same misfortune which already existed in overlapping authorities. At the present time that was exactly what occurred, and wherein the largest amount of mismanagement was sure to occur. Take Norwood, for instance. One portion drained down to Croydon, and the other portion into the metropolitan district. One portion was in Lambeth parish, and the other in Croydon, and there the conflict of authority was sometimes so great that there was no drainage at all, and in many parts of the parish there was a comparative difficulty in getting anything like a proper supply of water. It had nothing to do with rivers, because there was no river there. It had nothing to do with the conservancy, or the application of the Rivers Pollution Act; but when it was possible that the rating might apply to one portion of the county throughout, and not to another, persons would complain, in the same way that they did there, of having to pay higher rates for the purpose of supplying the wants, or removing the nuisance from a part with which they had nothing to do. When, therefore, the original factor, being the water-shed area, was again subdivided into one or more county authorities, there would be an element of considerable disturbance. Again, what process of absorption was to take place by which the present officers and authorities were to be dealt with, were they to be merely subordinates of the County Boards, as they now were of the Local Government Board, or to be absorbed by a totally fresh arrangement, by which the local authorities were to be superseded.

The Chairman said he knew of no suggestion for the suppression of the local sanitary authorities within the county, or for their being merged in the County Board, or subordination to it. What he said was, that if you

established a County Board, with functions of its own to perform, and established it on the lines of the local government areas in the county, so that every small local governing body in the county was practically represented in the County Board, by the process of the growth of institutions, the County Board would end by taking to itself some functions now exercised by smaller areas, and possibly by exercising some supervising functions over those smaller areas; but that was not matter for legislation at the time you constituted the County Board, but a speculation as to the natural growth of the future. With regard to the water-shed authorities, he was not quite sure that he apprehended Dr. Bartlett's views correctly—but you could not get over the facts of nature. If you had a water-shed partly in one county and partly in another, or if you had in one county two water-sheds, one of which was shared by one county and one by another, you could not get over the necessity for having some combined authority over the whole of each of those water-sheds. But if you wanted to avoid contention, you ought to do this: instead of creating some new body sitting astride the County Board, entirely independent of the county authorities, you would say to the adjacent county authorities, manage this amongst yourselves; have a joint committee, and let this matter, which is common to you both, be managed by a joint committee of the various Boards. With regard to the question of rating, there really was no difficulty at all; because, in any large governing area, much less that of a county—in an union, for instance—you had special drainage districts, and you had rates which were special and not general, and you could not deal with the question of the conservancy of rivers without entertaining the idea of such rates.

Mr. Owen said it would appear that the constitution of a County Board as a water-shed would only take place where there might be a river to be conserved. It would scarcely occur in a district like Norwood, where there was no river to be conserved, but merely a water-shed drainage.

The Chairman said the difficulty that Dr. Bartlett referred to would be one which would, from time to time, arise wherever you had boundaries. You could not erase the old boundaries; all you could do was to enlarge the areas, so as to minimise the difficulties.

Mr. Gould thought it was very important, in contemplating the creation of Local Sanitary Boards with great powers, and evidently with a tendency to add more and more to the important duties to be entrusted to that Board, that they should have some clear and definite understanding as to the constitution of that Board, and the mode of its appointment and institution. He referred to this because he came there as a member of the Thames Valley Joint Sewerage Board, smarting under the infliction of evils which had resulted probably from want of such consideration; and the question which he wished to call attention to, which laid the basis of all their action, was this, the promotion of local self-government by direct representation as against centralisation. They sometimes saw powers merged in the hands of what might be termed a beneficent central government, but they in England were led to have no confidence in that in which there was not direct responsibility to those who had to pay. The Chairman had spoken of County Boards, and he asked a question that morning as to how they were to be appointed. They had had painful experience that it was not enough to constitute a Board, and give it power, but the manner in which those powers were exercised would depend largely on the manner in which the Board was appointed, the persons by whom it was appointed, and the direct responsibility which existed between the members of the Board and those who appointed them. All the remarks pointed in one direction, and they all agreed with the view that a system of County Boards should be adopted, so doing away with a number of little petty powers, and having certain larger powers given to larger and more important bodies. That would, no doubt, be an immense advantage in the direction of sanitary improvement and local self-government. As to the different duties to be transferred to these bodies, they would all agree with what the Chairman had said, that they would be sure to accumulate as you went on, and as the body was found efficient and useful for its purpose. But he should like the question safeguarded in this way, that the County Boards should be directly elected by the ratepayers in each district. He was a magistrate himself, and was, therefore, not disposed to speak disrespectfully of the body to which he belonged; but they did look with a little anxiety, and sometimes with dissatisfaction, at the tendency to extravagant expenditure by the county magistracy, especially sometimes with regard to the lunatic asylums, jails, and so on; at all events, the complaint was the want, on the part of the ratepayers, of direct representative influence and control. They did not want to see the County Board constituted of *ex-officio* magistrates of the county. That would be the greatest possible mistake that could be made. He would rather have every member of the Board elected directly by the ratepayers, for he was satisfied that only in that way would they have the best men selected to fill the duties entrusted to them. He would shortly state his reason for this opinion. Mr. Chadwick had referred to the local unit, the parish, having been taught the lesson of the advantage of combination for Poor-law purposes into a Union, and one would have thought that lesson would have been the very lesson taken in the appointment of a Board with the extraordinary powers of the Thames Valley Joint Sewerage Board. But nothing of the kind. He spoke now because he feared that if attention were not directly called to it, and they did not safeguard the resolution in some way, the Government would say never mind about the mode of appointing a County Board, leave all that to us, and it might turn out as in the case of the Thames Valley Board, there was a body without an atom of responsibility to any of the ratepayers, or the persons affected. How was the Board elected? By the Local Government Board. There were many sins of omission and commission charged against it, and he thought that might be included in them, and it was admitted before Mr. Raikes to have been a grave mistake. Instead of following the experience of the parish, and adopting the system for the election of the Guardians by calling on every ratepayer in the district to vote for the very best man that could be placed on this Joint Drainage Board, considering it was a Board whose duties were of such a peculiar character, requiring, perhaps, a higher degree of qualification than was needed for any municipal, parochial, or official duty, what was done? Nobody seemed to know how it was done, but the local authorities of each place in the district, whether the Corporation, as at Kingston-on-Thames, the Commissioners, as at Surbiton, the Local Board, as at Moulsley, or the Vestry of somewhere else, each elected two, three, or four out of their bodies, and they were constituted the Joint Drainage Board. From his own experience, he did not hesitate to say that a greater mistake could not have been made. If direct representation had taken place, it would have been impossible to have such a failure as they had had, and such discouragement to sanitary work caused by the Board called into existence with enormous powers, and existing now for two and a-half years, and having spent over £20,000 in a local inquiry lasting 45 days. There were something like 70,000 questions and answers put to decide the simple point as to whether a site at Moulsley was fit for sewage irrigation or not. Such a thing could not have happened in a properly elected body. You had the chairman of a Local Board of a place acting in direct defiance and opposition to the Board which sent him there, and to the whole body of the ratepayers, and misrepresenting their interests.

He himself was put there, and could not be removed so long as he held the office of a member of that Board, or Corporation, or a Board of Guardians; there he was fixed as a member of the Joint Sewerage Board, and by such appointment the public interests might suffer very materially. That was why he was anxious to bring forward this point, that if they were to have County Boards, or drainage area Boards, or Water-shed Boards, they should be constituted in accordance with the principles of direct representation and responsibility.

Mr. Cresswell rose to order. He had listened with the greatest possible interest to the remarks of his friend Mr. Gould, but he thought he was touching on political questions, which were rigidly excluded from discussions there. The constitution of the county authority was eminently a matter for Parliament.

Mr. Gould said he would take the sense of the meeting upon that point. When Mr. Cresswell said before it was a political question, he thought he meant it in a party sense, but he had no idea of anything of the kind. He merely wished to do what was legitimate, but he did submit that it was fairly within the scope of the discussion, before he gave an opinion or a vote that there should be a County Board elected to watch over the interests of the district in which he lived, that he should know that that County Board should be only elected by the ratepayers, and with direct responsibility to them. What such a body should do would be a mere matter of detail afterwards, but he asked the meeting not to commit itself blindly to the approval of a body without knowing the form in which it should be elected. They should only recommend it on the condition that it was based on the principle of direct representation, and he begged to move that as a rider to the resolution.

The Chairman said, in his opinion there was nothing out of order in the amendment, because the method of election, whether direct or not, and whether it should be by ballot or not—which was a question raised by Mr. Cresswell in preceding years—was in one sense political, but they were quite within their province in dealing with it, as it had a bearing on the character and efficiency of the Board to be constituted. It was a question, however, whether it was advisable to go into the matter. He agreed with the remarks just made, and, if the opinion of the Conference was in favour of enlarging the resolution in that sense, he thought it had better be done in this way:—"That this Conference is further of opinion that such County Board should be instituted with the least possible delay, and that it should be elected directly by the ratepayers by ballot," and then go on, "and that the functions entrusted to them," &c.

Mr. Gould said that would entirely meet his views.

The Chairman said if that met with general concurrence, he had no objection, but if there was any feeling on the part of any considerable number against it, he thought it would be better not to press it.

Mr. Chadwick said the question of election by ballot was a large one. If the ballot were to supersede the house to house collection of votes, as was the practice in the election of Guardians, it would be superseding it by a mode of election by which a very small number of votes were obtained, and would introduce the corruption which pervaded general elections, the corruption of payment for people to give their votes. It might be done, as was done in charities, by voting papers.

Mr. Gould said he did not contemplate a political election by ballot; it might be done as the election of Guardians. He did not wish to go into any details at all, but only to affirm the principle.

The Chairman said he would strike out the words "by ballot."

Mr. Schofield (Mayor of Rochdale) said he should like to say a word on the aspect of the question just put by Mr. Chadwick. His experience, as a Guardian for many years, was quite opposed to the view that gentleman had stated.

Mr. Alcock said his experience as a Guardian was in favour of Mr. Chadwick's views. Not only a greater number recorded their votes, but much greater attention was given to the matter by those who did record their votes, and in choosing the candidates they voted for. Another question arose with this of direct representation. The expenditure the persons were put to in connection with elections was becoming almost intolerable.

The Chairman suggested that it would be better to strike out the clause, so far as the present resolution was concerned, to avoid any difference of opinion, but keeping in the words that they should be elected directly by the ratepayers.

Dr. Bond said he was willing to agree to the phrase, "a representative County Board," but it was a very grave question whether the election shonld be entirely or partially direct. He thought the meeting would unanimously agree to simply using the word "representation," leaving to Government to determine how the representation should be made.

Mr. Gould said that was the mistake. The various bodies he had referred to sent gentlemen to the Joint Sewerage Board, and that was called representation; but there was no election by the inhabitants, and no responsibility. You might have representative elections, and yet no direct election by the ratepayers or direct responsibility to them.

The Chairman said, as this resolution was an important one, it was very desirable they should pass it unanimously; and he would suggest, therefore, that Mr. Gould should afterwards propose what he wished as a substantive resolution.

Mr. Monson pointed out that there was a great difference between a County Board and a Water-shed Board, inasmuch as counties were usually divided by rivers, whereas water-sheds were divided by hills, and therefore it would require different authorities for the conservation of rivers to those for the county. With regard to the question of election, he thought if every ratepayer were to vote, the machinery would be so cumbrous that it could not be carried out, and the cost would be too great. Although the joint Board of the Thames Valley had turned out a failure, yet, with regard to the manner of the election, it ought to have been right.

The resolution, as originally proposed, was then put and carried unanimously.

Mr. Gould then rose to move the resolution with regard to the mode of election, but

Mr. Cresswell suggested that it would come on better under the heading No. 3, which dealt with the mode of election.

The Chairman then invited the Conference to discuss heading No. 2, "Sanitary Districts." He thought it was not necessary for the Conference to arrive at a positive resolution on every one of these propositions put down for discussion, but his idea was that they should aim at concentrating all functions in one body, and making the unit of the area within the county as large as conveniently might be.

Mr. Alcock said there might be a unit proposed which, in the northern parts of the kingdom, met with anything but favour, namely, the petty sessional district. The question seemed to be between that area and the Union, and he thought it almost desirable to pass a resolution that the Union should be the unit of area.

The Chairman said the petty sessional area was proposed as the unit of area for election purposes for County Boards, but in the House of Commons he pro-

posed an amendment, that the elective area should be the administrative unit of area. Here, however, they were concerned with sanitary districts; for instance, urban or rural sanitary districts, the areas of Local Boards and the areas of the Board of Guardians. The second proposition was that all these should be as large as conveniently might be, to avoid the multiplicity of small Local Board areas.

Mr. Alcock thought, for a combined area of sanitary and Poor-law administration, which they would have to come to ultimately, they could not have a better unit than the Poor-law Union.

Mr. Chadwick said there were a great many things pleaded in favour of that view. First, the Union had a Medical Officer of Health, and it was now by necessity, frequently, the sanitary authority. The Petty Session had criminal and police functions, but the Union was not only at present the unit of sanitary administration, but had become the unit of educational administration, and would, he believed, become the unit of all other local administration, and, therefore, it ought to be preserved.

Dr. Bond proposed:—"That it is desirable, as far as practicable, that local authorities should, in all cases, be constituted the local governing body, for all purposes for which their area is fit."

Captain Galton said he apprehended Dr. Bond's meaning was that the School Board duties should also be performed by the same Board which looked after the sanitary work of the district and the Poor-law work.

Dr. Bond thought that would be very desirable, but it was a doubtful question.

Captain Galton said, although he thought it would be a most desirable thing if they could obtain one set of people to administer the whole of those duties; still it might be rather questionable whether they should propose this at the present moment, before it had been more ventilated.

Mr. Cresswell said the question of uniting the administrative area having been raised, if Dr. Bond's resolution was passed, with which he cordially agreed, that the local authorities of urban and rural sanitary districts—

Dr. Bond said he did not introduce the words "urban and rural;" he simply said the sanitary authority.

Mr. Cresswell said if they once guarded the resolution in this way, that the local authority should be constituted the local governing body for all purposes for which the area was fit, you established the unit itself, because the question of Poor-law Guardians or of Union would never arise. There would be no Union. The effect of this would be to abolish all unions of Guardians whatever. Each local body in each district would be the Board of Guardians, and the unit he desired would be obtained at once. The jurisdiction of the local governing body, as the County Board would consist of representatives from each Local Board or district, would be the unit for that purpose.

Dr. Bond said the only object of the resolution was to affirm the desirability of consolidating and concentrating administration. He failed to see the objection Mr. Cresswell had taken.

Mr. Cresswell said he did not object at all to the principle, he only objected to the term. If you once asserted that one governing body must be the governing body for all purposes, the unit must be the unit of jurisdiction of that body.

The Chairman said the resolution was, that it is desirable, as far as may be found practicable, that local government bodies should be local authorities for all purposes for which their area is fit. When you had a large and populous area, so that the functions of local government became too wide, you had to subdivide them; if you had a small area, the policy was to concentrate them.

Mr. Gould asked if they were not going far beyond the sanitary question; and would it not be a pity to complicate the most important question of all, that of sanitation, by mixing up other questions with it.

Mr. Monson thought the present division of administration was as good as they could have. Local Boards watched over the roads, sewers, and that kind of work, and some men were well qualified to attend to it; others could attend to the School Board, and others acted well as Poor-law Guardians, but he thought it would be a disadvantage to combine all these things together. They found, in Local Boards, it was better to divide them into wards, and not to extend over too large a ground.

Dr. Tripe said he objected to Dr. Bond's proposition, not only on the grounds already mentioned, but because it was incompatible to have Poor-law work mixed up with sanitary in which case the sanitary work was generally relegated to the end of the business, and often came to nothing, and the same thing might be said if the Local Board work were added. He thought it would be better to make sanitary work a kind of speciality; and further than that it must be remembered that urban and rural sanitary Boards are in quite a different position as regards their sanitary powers. At the last Conference, it was proposed that the districts should be larger instead of smaller, but the tendency of this amendment would be to reduce instead of extending the areas, and he, therefore, thought it would be retrograding.

A Member said he saw by the title of the pamphlet that this was an Annual Conference on the Progress of Public Health, but he failed to see how public health was to be affected by going into the general constitution of local administration on every subject and something besides.

Professor Way did not see why the question of police, lunatic asylums, and anything else should not be discussed as well as education, if anything beyond sanitary purposes was admitted.

The Chairman said he had no strong opinion on the subject, and it must be remembered that they had no such thing really as Sanitary Law, although the term was often used. The laws which affected health were also laws for the convenience and welfare of the population of a place, of which the sanitary aspect formed one. It was entirely germane to the question to consider the process by which you could divide the country into the most fitting areas for this purpose, and govern them by the most independent, responsible, and reliable Boards, so that logically speaking you were entitled to say that you had a better Board if you added to its functions. And there was another reason why, after all, the subject was not strange to them, that in rural districts, at this very moment, the governing body for sanitary purposes was the governing body for Poor-law purposes as well as for education; still he admitted that this was a subject on which it was not easy to come unanimously to a very specific resolution, and perhaps it would be well not to press it.

Dr. Bond said he would withdraw the resolution, though he was sorry to find there was so much opposition to it.

Mr. Cresswell said the Legislature had already recognised the principle of concentration. If the Board of Guardians was fit to be the rural sanitary authority, why should not the rural sanitary authority be fit to be the Board of Guardians?

Mr. Chadwick said it seemed to be forgotten that formerly the parish was the unit of administration

There was the parish doctor and the parish school. Although the Union might have its functions in certain districts—and no doubt it was an advance on the parish, because it had paid officers under some responsibility, which the parish never had—still in larger districts like London it was found that special functions, such as of education, were exercised by a special Board. So in Manchester there were five or six Unions, but the education was undertaken, as in London, by one Board. All these things should be settled by local inquiry.

Dr. Carpenter said he had great sympathy with the proposal put forward by Dr. Bond, although there were many exceptions to it in its entirety. Although, at the present moment, not being a member of a Local Board, as he had been for many years, he was a member of the petty sessional division, and that authority had charge of cow-houses, and the carrying on of the Contagious Diseases (Animals) Act, and had to look after many matters connected with the health of the people, which ought properly to be in the hands of the sanitary authority. So with regard to the conflict of jurisdiction which occurred in his district, where some questions affecting the health of the people were under the petty sessional division, others under the urban sanitary authority, and others under the Board of Guardians. If they could have that unit of organisation whfch Mr. Cresswell spoke of, it would be an advantage, especially if it were so arranged that there should be different bodies connected with it which might make their applications for money to one common financial Board. There certainly ought to be only one rating in a district. He thought, if the resolutions were accepted, it would be to some extent helping the Legislature, and be a service to the public in pointing out that all matters connected with the health of the people, from whatever source they arose, should have their operation through one particular Board in one district. There were many matters connected with health which were not at first sight sanitary, but which really ought to come under one Board to be carried out.

Dr. Bond said it had been suggested to him that perhaps the meeting would accept the resolution if the word "sanitary" were interposed.

Dr. Carpenter said in their own district the Board of Guardians had established hospitals for infectious diseases, which were satisfactory and sufficient for the district, but the Local Government Board had called on the urban sanitary authority to provide infectious hospitals also in the same district. You were ordered to have there in the same district two centres of infection, instead of one, and to his mind it did seem to be a mistake that that should be carried out. If any change were made, it should be the transference of the treatment of infectious disease from the Guardians to the sanitary authority. If that were done, and the "destitution" authority were to pay for the maintenance of paupers in the hospital, the difficulties which now existed would be obviated; but if one body were constituted for the purpose of dealing with disease, that diffiulty would not arise.

Dr. Wright (Cheltenham) said that much of the confusion and mischief which had arisen in the city of Bath arose from this want of proper authorities. There was a constant conflict going on between the sanitary authority, the Town Council, and the Board of Guardians.

Mr. Donville supported Dr. Bond's amended resolution. If the resolution were passed without the insertion of the word "sanitary," it would not work in many large municipalities. As it was, it was found that Town Councils were always overworked; and it was difficult to get members to attend regularly, or remain throughout the sittings; where they constituted an urban sanitary authority, as well as a municipal authority, so much time was taken up that it was difficult to find men to give the necessary attention to the different branches of the work. In these days, when it was the tendency of Town Councils to take the charge of gas and water supply, and many other undertakings, which, previously, were not under their jurisdiction, any addition to their duties would much impair their usefulness.

Captain Galton asked Dr. Carpenter if the case to which he referred was not a mistake on the part of the sanitary authority or the Local Government Board.

Dr. Carpenter said they were perfectly well aware of the circumstances of the case, that the Local Government Board said distinctly, although there was sufficient accommodation in the district for cases of infectious diseases provided by the Board of Guardians, still the urban sanitary authorities must also provide similar accommodation for patients who were not paupers. Now, in a large place like London or Liverpool, where cases of infection were constantly occurring, such a hospital might be needed, but where the cases were few and far between, it seemed monstrous that two bodies performing corresponding duties should be compelled by law to set two centres of infection in one district, when one would be sufficient.

Dr Vacher said a similar condition of things obtained in Birkenhead, except that there the sanitary authorities had provided accommodation for infectious patients, and after that the Guardians received a notice requiring them also to provide accommodation for pauper patients. The hospital, which was provided by the authority he represented, held 18 beds; at present they had two patients in it, sometimes there was one, and sometimes several weeks passed when there were none in it at all.

Mr. Shawcross (Rochdale) said he could corroborate the experience of Dr. Vacher and Dr. Carpenter. Although they had a large infectious hospital built by the authorities, they had to appropriate part of the workhouse for the purpose.

The Chairman said the inconvenience arose through the want of a little more legislation. When he introduced the Local Government Bill, it consisted of many chapters, and the last contained a number of minor practical enactments, but he had to abandon that in order to succeed in passing the organisation part of the Bill. In the last part he provided for this contingency, and he was not quite sure it had not been provided for in some subsequent legislation. All that was required was a clause enabling the sanitary authority of the place and the Guardians to come to some arrangement. With regard to Dr. Bond's amended resolution, he was afraid it meant so little that it almost meant going back, because already, in rural sanitary districts, they had got beyond it. He was in favour of the combination of functions, and though he was aware that Guardians often got in the way of doing the sanitary work last, he thought it would not continue to be the case.

Dr. Bond said he felt the resolution was so emasculated by the insertion of the words suggested, as not to be worth carrying, and therefore he would prefer to withdraw it altogether.

Dr. Vacher said there were powers by which Guardians and sanitary authorities could come to an arrangement, only they were like oil and water, and would not mix. They had deputations and mutual Conferences, but it all resulted in nothing.

Dr. Bond said it was because the Local Government Board had no compulsory power.

Mr. R. Rawlinson, C.B., said within the last three months he had been to Brighton to hold an inquiry as to the corporation acquiring a site for an infectious hospital. The Guardians, up to that time, had been dealing with infectious cases, but declined making any further provision for patients, and consequently the corporation was driven to make a second hospital.

Dr. Yeld said the character of the patients must also be borne in mind. His own experience in a large town had been that patients who suffered from infectious diseases amongst the middle and upper classes were perfectly willing to go to the hospital of the urban sanitary authority, but refused point blank to go to the pauper hospital. That was one of the great difficulties which would be found to exist, and he did not see how it was to be avoided, unless the Board of Guardians gave up the infectious hospital to the urban sanitary authority, and kept special wards for special patients.

The Chairman then invited discussion on paragraph 3, the election by ballot instead of voting papers.

Mr. Gould said what he wished was simply to carry out local self-government with all responsibility attached to it, and he begged to move, "That the election of members of such County Boards shall be by direct election of the ratepayers of the district." He left out the question of the ballot, because it might be carried on in the way Guardians were now elected.

The Chairman asked if he would not include all boroughs?

Mr. Gould said yes, because they had powers of rating.

Mr. Owen seconded the resolution, and said he had the strongest feeling in sympathy with the proposition. The ratepayers desired, on all occasions where it was practicable, to be represented, and to have the election of the representatives in their own hands. This was shown by the fact that there was at this moment existing in Exeter what was called a ratepayers' association. He was not there to represent the association, but it illustrated the strong feeling which existed on the part of the ratepayers to be properly represented.

Captain Galton, C.B., suggested that they might add to the resolution, that all local elections should be held on one and the same day, so as to minimise the trouble and economise the time of electors.

Mr. Gould said he was quite ready to accept it.

Mr. Adolphe Smith submitted whether it was advisable for the Conference to define what should be the qualification of the suffrage for the election, either of the County Boards which they wanted to create, or of other local authorities. He thoroughly sympathised with Mr Gould in his desire that the Boards should not be elected in the second degree like the Thames Valley Sewerage Board, but that they should be directly elected by the people; but he did not think it would be quite wise for the Conference to define the nature of the suffrage. It was defined because it was limited to ratepayers. At the present moment local government did depend on the rating of ratepayers, but it was a question whether it should continue to do so, as it was quite possible that the same qualification would enable a man to elect a municipal councillor as applied to members of the National Assembly. He would therefore propose, as an amendment, that the elective principle on its widest basis be recognised, but not specifying exactly what should constitute an elector.

Mr. Rawlinson, C.B., said Local Boards were elected for a different purpose to members of Parliament; they (the Local Boards) had to spend money. He could not imagine that that would be a proper mode of election, by which persons who had no money elected those who had to spend the money of those who had. He should be sorry to see that power thrown into the hands of what he might, without offence, term "the mob." He might state that the greatest opponents to sanitary progress he had known had not been the men of property, the wealthy men, the largest ratepayers, but, almost without any exception, the lowest class of ratepayers, and in many instances the most beneficial improvements had been opposed by persons who paid no rates, and would have no responsibility put upon them, or any weight of payment whatever; yet they were foolish enough to sign a memorial to stop the work which was to be for their especial benefit, and not to touch their pocket.

Mr. Day (Reading) thought it would be impossible to have all the elections on the same day. You would have the elections for councillors, auditors, assessors, Boards of Guardians, and he was not sure whether there would not be one or two others. It would be utterly impossible to carry it out.

Mr. Gould said he understood it only referred to elections of this body, not that all parochial and other elections should take place on the same day.

The Chairman said the proposition was that there should be one day in the year for these elections.

Mr. J. L. Muspratt (Widness) said he should like the question of the ballot to be introduced into the resolution. In his district, a great number of the voting papers for the Local Board were not filled up, and for the Local Board of which he was a member in Lancashire, with a population of something like 20,000, at the last election, one-third of the papers were absolutely unsigned, or the people could not be found, or else the papers were spoilt through some omission or addition to them.

Mr. Taylor (Shipley) strongly supported the suggestion. With regard to voting papers, in some cases canvassers went round and filled up the papers how they liked, and the next one that went round, if there were four required, would put in a fifth, so as to spoil the whole thing. He was deputed to come there and say they were very strong on this subject to have the ballot, and only to have one vote. They had no fear of entrusting the management of the Board to the hands of the working class, if the ratepayers liked to send them, for they were men who would do the work properly. Unfortunately, their Board had been entrusted to men of position who had neither done it nor cared any thing about it. They found the lower down they went with the qualification, the better they got the work done. Therefore they wanted to have the ballot, and only one vote. A person paying over £100 in rates could give eight or ten votes, and that was unfair. As to spending money, members of Parliament spent any amount of money, and so they did in the Town Councils and on the Boards of Guardians.

Mr. Chadwick said it was quite possible to have balloting papers collected from house to house; but, in respect to the method of election, he would mention that in Manchester there was a house to house collection of votes whether they should have the supply of water from Thirlmere or not, and, on that occasion, 40,000 votes were collected by the police, instead of by partisans, at the rate of 4d. a vote. In many elections for Town Councils, the candidates were elected by positive minorities at an expense of some shillings a vote, and Parliamentary elections cost 10s. to £1 a vote. The plan he recommended saved labour, money, and a great deal of corruption. Appeals against elections by voting papers were decided gratis, but there were very few, and those not for corruption, but chiefly for irregularities in form; whilst there were forty-six for bribery and corruption in the last elections. The payment for the labour of attending polls was the seed plot of corruption, and of enormous expense. On the School Board elections the expenses were scandalous. Indeed, ballots were now taken for the elections for charities by post, the balloting paper being returned in a closed envelope.

Mr. Alcock thought it would be a great pity to decide that the elections should be by direct representations by ballot, and all on the same day. He should have no objection to saying that these Boards should be elective or representative, but to say that they should be by direct representation from the ratepayers,

was a very serious matter to any gentleman who had been acquainted with elections, in large towns more especially. The expense to a candidate for a Local Board, for a town of any size, was becoming a very serious matter, and of course, gentlemen elected to Parliament knew that also to their cost. He heard some one say, "Why is it?" but he should like that gentleman to devise a means why it should not be. The only election carried on, to his knowledge, without cost to the members, and with very little cost to the ratepayers, was that of Guardians; and, in his experience, the ratepayers both exercised most carefully their powers of filling up the voting papers, and considerable discretion in picking out the members who they considered best qualified to represent them. But when you came to an election for Local Boards or Councillors, very few get in without considerable expense, amounting in large places to as much as £100. It was a shame it should be so, but it was the fact; and if you were to have the County Boards elected by the ratepayers direct, it would be as expensive as a county election.

Mr. Shawcross said he could contradict that view from his own experience.

Mr. Alcock said that it was quite true that in School Board elections, very often sets of gentlemen combined amongst themselves, and carried in certain candidates free of expense to them; but they were not carried in without expense to somebody. In the north, at any rate, there was great expense to anyone who stood by himself. He did not say there should not be a certain proportion of direct representation; but he thought they would meet the case if they said the Board should be elective and representative, leaving it to Parliament to consider how that representation should be carried out. He believed very few members who had served long on Local Boards would come forward as members of County Boards if there was this expensive method of election, and the result would be you would have the County Board not containing representatives of the local bodies which formed the units of the administrative area, which would be a great disadvantage. He trusted the Conference would pause before accepting the resolution.

Mr. Schofield was surprised to hear these statements as to the expenses of elections in different places. They differed very widely from his own experience, both as a Guardian and a member of the Corporation, extending over many years. It had never, though his seat had generally been contested, cost him £1 for his seat, from the first day until now; and how gentlemen could come forward, and say that it must cost so much a-piece, he did not know. It might be the case that money was expended, but why it should be expended was the point he could not determine. It certainly was not necessary. If gentlemen would stand, as had been said, on their merits or demerits, and let the ratepayers decide whether they would have them or not, there would be no necessity, in one district or another, for spending money.

Mr. Donville asked how Mr. Schofield made his candidature known.

Mr. Schofield said it was made known by the local authorities.

Dr. Bond said he thought Mr. Schofield must represent Elysium.

Mr. Schofield said he represented about as Radical a constituency as any of the kingdom—Rochdale. The system of sending round voting papers to the different houses was one which admitted of the greatest possible abuse. Immediately they were delivered, there were persons sent out by each side, and the question was who could first lay hold of the voter, and fill up the paper for him. The papers came in in many instances without any signature at all, and very often, from what were considered the most intelligent people, there was some mistake in filling up, and the voting papers were lost.

Mr. Chadwick said when the complaints were investigated they turned out to be very small, and cases of corruption were hardly known, whilst in Parliamentary elections there were 40 or 60 petitions now pending.

Mr. Schofield said they did not get the opinion of the ratepayers by voting papers. Take the Union of Chorlton. Almost every person must have read the statements in the papers of the thousands of papers which came in without any signatures at all, and others in such a fashion that there was no making out how the people intended to vote. He heard one Guardian tell the chairman of the Manchester Board that for a £30 note he would undertake to unseat every man.

Mr. Chadwick said it was not so in the majority of cases.

Mr. Taylor said the ballot had been on trial for many years, and was now going to be renewed, and that was a fair guide to go by. As regards expense, a man might go to any expense, either by ballot or by voting papers, but he had been elected twice, and his election had never cost him a penny. Those that liked to pay to be members of a Board might do so, but it was not necessary. One thing he wanted to ask was this: What they understood by the members of a Local Government Board being elected partially by representation. As he understood, the ratepayers had to pay the money, and why should they not choose the time? He did not see why they should be called upon to pay for anything unless they elected the men who spent the money. Who were to be the other parties? If they were to choose two-thirds, who were to choose the others.

Dr. Yeld said, although representation might not come direct from the ratepayers, as illustrated by Mr. Gould, still the ratepayers had the remedy in their own hands if they were not satisfied. If the representatives sent from the various Government Boards did not act in accordance with the wishes of the constituency they represented, the first opportunity that came round they would lose their seats. He would also point out that at the present time there was a superior authority for sanitary purposes appointed in a similar way, and he never heard that such authorities were not able to do their work very well.

Dr. Bond applied to Mr. Gould to follow his example, and withdraw the resolution, as they were certainly by no means unanimous.

Mr. Alcock begged to move, as an amendment, that the members of the County Board should in all cases be elective and representative.

Mr. Gould said he did not think that on all occasions it was necessary or desirable that uniformity of opinion should exist, and if they were only to depend on perfect unanimity, they would leave a great deal of business undone, after a great deal of discussion, and time lost. He gathered from the remarks of some gentlemen that the objection was not so much to direct representation as to the mode of election. But he left that open to be debated or suggested by the meeting. The principle he wished to lay down, which was, to him, a matter of conscience, was that there should be a direct representation and direct responsibility. He would not go into the question of the ballot. He could only say a good deal of fallacy existed with regard to expense. He, himself, had been a member of the Town Council of Kingston for 26 years, and had never been asked to spend a penny. A deputation from the burgesses called on him and asked if he would serve, and that was all; he had never known any other course adopted. He did not believe a shilling was spent necessarily or voluntarily in connection with the proposed elections. If they were to wait until they got a system which would be so perfect that no man could abuse it, they would never have

any election at all, because even the ballot, with all its excellencies, was admitted to be open to abuse. He did not know why they hesitated about affirming the principle, because there might be some doubt or difficulty about the mode of election. Some gentlemen objected to election by the ratepayers, but how would they propose the election to be. Partially necessarily meant that some would be elected by the ratepayers, and some in some other way; but, in his opinion, there should have been none but those elected directly by the ratepayers. That was the principle he would lay down and act upon, and it was one he asked the meeting to affirm, for he had seen and known the importance of it. One gentleman said the ratepayers had the remedy in their own hands, and he wanted them to have it in their hands, but they had not now. On the Drainage Board to which he belonged, he was an Alderman of the Corporation of Kingston, and was elected for six years; and under the present system, however much the ratepayers might be dissatisfied with his conduct, they could not remove him until a vacancy occurred, at the end of six years, and then they did not elect him, it was the corporation. The ratepayers had no control over his conduct whatever. The fault of that system was this, there were some gentlemen who made admirable Guardians, Councillors, or Vestrymen, and who received the highest commendation in that capacity, but whose conduct on the Sewerage Board was bitterly complained of. Yet it was felt if such a man were displaced, they would be turning out one of the most valuable Guardians; and so of two evils they chose what they thought to be the least, though at the same time they passed a resolution condemning his conduct at the Board. In this secondary method of representation, it was done by the friendly feelings of one gentleman for another, instead of by the proper regard to the necessary qualifications.

Dr. Bond said he did not understand how Mr. Gould, as an alderman, entrusted with the expenditure of money, reconciled his opposition to the indirect election of County Boards.

Mr. Gould said the explanation was perfectly simple, if time allowed for going into it.

The Chairman then read the resolution and the amendment, and put the amendment to the meeting, which was lost by a majority of one. The original resolution of Mr. Gould was then put, and that was also lost.

Mr. Rawlinson said he believed the Conference were interested in sanitary progress, and that, as he held that house drainage was at the root of all sanitary reform, he was pleased to inform them that Lord Spencer had kindly permitted as many as thought proper to go and inspect the system of drainage at his Lordship's house, at St. James's. He undertook to say, that at that moment, as far as his knowledge extended, it was the most perfectly drained house in London or elsewhere. Until the drains were taken in hand, however, it was in about the worst condition of any in London, there being several large cesspools in the basement, and the stable drains were as full as they could be. The new system had been designed and executed by Mr. Griffiths. He might say, that no later than 1844, cesspools were very common. Windsor Castle had 51 within its basement, and there were thousands of houses in London at that moment which had the old cesspools in the basement that had never been removed. Gwydyr-house, of which the first Board of Health took possession in 1848, had nine cesspools in it. It was worth while for the Conference to see how completely that abominable system could be got rid of, and he was anxious that as many as possible should see with their own eyes how it was done. It had been said very truly that half-knowledge was almost worse than ignorance, and this amount of half-knowledge on sanitary matters was very common. He was sorry to say that sanitary works had been designed and executed with the half-knowledge which tended to injure, and not to improve. Hence they had house-drains denounced in the most virulent manner, and water-closets denounced as the producers of disease in every form. That was because the persons who executed the works had either misunderstood or mistaken the true principles of drainage, and had so arranged the water-closets and drains that, instead of being conduits to take foul matter out of the houses, they had been conduits to take foul gases into them. At Spencer-house, however, it was absolutely impossible for the very spirit of mischief to do anything to those drains which could cause offence within the walls of the dwelling, and the stables were put under just the same improved conditions. Lord Spencer told him, at the begining of the spring, that he could not say the improved state of his health was in consequence of what had been done to the drains, yet he had never been so long in London previously without suffering from sick headaches; and then, with regard to his horses, his groom told him that within a week or so of their being brought to London, they always used to go back in condition, but they did not do so this year, and of course he said he must attribute that to something which had been done.

The Conference then adjourned.

MISCELLANEOUS.

ARTISTS' COLOURS.

A meeting was held on Tuesday, 8th inst., at the Grosvenor Gallery, New Bond-street, to continue the consideration of the subject of Mr. Holman Hunt's paper read before the Society of Arts, on Wednesday, April 21st. Sir Coutts Lindsay, Bart., took the chair. Mr. Holman Hunt exhibited several canvases, upon which different colours and combinations of pigments had been laid some years ago, with a view to see what changes would take place. Many had changed considerably. With regard to one canvas, Mr. Hunt said that, wishing to try some Indian colours that had been sent to him, and having no oil at hand, he sent out and bought a bottle of oil bearing upon it the name of a celebrated dealer, and used it to mix with the colours. That was in March, 1879, and the colours on the canvas were still as wet as on the day they were laid on. In the discussion which followed, Mr. E. Fielding pointed out that there were different modes of preparing vermilions and other colours, and that much would depend upon the particular method adopted. With regard to the vehicle, the artists' colourman had to trust very much to the varnish-maker, the composition of the vehicles being trade secrets. Mr. Arthur West made a communication with reference to a book formerly belonging to Mr. Field, and now in the possession of Messrs. Winsor and Newton. This contained directions for the preparation of colours, of which specimens in the book had been produced about 70 years ago, and were as perfect in tint now as when first put in. Mr. Church, Professor of Chemistry of the Royal Academy, said it was now about a quarter of a century since he first began to make experiments with pigments, oils and varnishes, and painting grounds. The movement which Mr. Hunt had begun must, it appeared to him, take a wide range. To begin, for instance, with the oils to which reference had been made. The best colourmen were at the mercy of the oil-seed crushers. It might be East Indian, Russian, or Italian oil-seed; and these would vary greatly. Taking the worst of them—the East Indian—that would be found to contain a certain per-centage of non-drying oil, due partly to the presence of mustard and rape seed with the linseed, and

partly to the fact that from seed crushed by hydraulic pressure at a high temperature a not inconsiderable quantity of fatty matter would be expressed. After speaking of the effects of mixing various pigments, he mentioned, by way of example, that there were three varieties of Prussian blue, of which only one was permanent, which might be easily distinguished by the employment of certain chemical and physical tests. In making experiments with colours, he would suggest that the pigments should be spread on glass first, because the preparation of the ground on the canvas might vitiate the experiment. Next, the colours should be laid on white porcelain, because any change of tint could then be better observed; and thirdly, some should be put upon canvas the composition of the priming of which was known. Other speakers followed, and Mr. Joseph Stapleton having given the results of analysis of colours made by him for Mr. Holman Hunt, Sir Coutts Lindsay summed up the discussion, and said that the meeting had not been held fruitlessly. Some valuable and interesting information had been obtained from various speakers. From what they had heard he would venture to say that Mr. Hunt had been amply justified in the course of action he had taken in calling attention to this subject. Mr. Hunt had not attempted to prejudice the public in any way against the colourmen. He had only asked that inquiry might be made respecting the colours used by artists. So far as the matter had yet been investigated, there appeared to be grounds for a careful consideration of the subject. There could be no doubt that there were many colours which might be very good in themselves, but were sold under false names. These colours might be quite harmless, but the practice of selling anything under a false name was misleading to the artist and deserved reprobation. He believed, as one speaker had said, that there was no more honourable men as a body than artists' colourmen, but they were constantly forced by the demands of the artists to sell things in a way they would not wish to do. Artists wished pigments to have qualities which those pigments in their nature had not. For instance, they wanted Naples yellow to have a very brilliant bright colour, and to satisfy this desire for brightness the colourmen were induced to produce something which was not really Naples yellow at all. Artists were, he thought, quite as much to blame for the present state of things as the colourmen. They and the colourmen were not in proper relations with each other. The colourmen wished to please the artists, and the artists were very often unreasonable in their demands. He hoped that the outcome of this meeting would be the awakening of an interest in the subject on the part of the public. A vote of thanks to Sir Coutts Lindsay, for the use of his gallery and for presiding, brought the meeting to a close.

MONEY ORDER TELEGRAMS.

A system of telegraph money orders was commenced in New Zealand, on the 15th June, 1871, and the Postmaster-General, for that colony, reported on the 14th August, of the same year, that it had already proved highly successful. In the twentieth annual report of the Postmaster-General, dated Wellington, 18th July, 1879, it is stated that during the year 1878, the telegraph had been used for the transmission of 13,228 orders, amounting to £54,807 10s. 6d. In the previous year, 12,478 orders for £55,683 were sent by wire. The Commissioner of Telegraphs, whose report is for the year ended the 30th June, 1879, writes as follows :—

"The number of money-order telegrams sent during the year was 14,607, representing a value of £61,693 9s., being an increase over the previous year in messages of 1,807, and value of £6,770 18s. 7d. The commission collected by the Post-office on these transactions amounts to £1,758 9s. 4d. From this amount has to be deducted the sum of £730 7s. as fees on telegrams, which leaves £1,028 2s. 4d. to the credit of the Post-office, which is equal to 1,666 per cent. upon the total amount transmitted. Wellington stands first as having issued the largest number of orders, Christchurch, Auckland, and Dunedin coming next in the order mentioned as regards the number issued, although the money value of the orders issued by Dunedin exceeds that of Auckland by £750 3s. It is satisfactory to note that this convenient method of transmitting money rapidly at a small cost, is steadily increasing in public favour."

CORRESPONDENCE.

IMPROVEMENTS IN VIOLINS.

The public have reason to be thankful to Mr. Walduck for his experiments with violins, and I in particular, because I am saved the trouble of similar ones which I have long desired to undertake. There is but one further step which I will venture to suggest, namely, to try the effect of substituting for the sound board or diaphragm of pine or sycamore one prepared with something like the peculiar charcoal which has been found so sonorous in the microphone. Special attention must of course be paid to the mode of supporting it. T. Twining.

Twickenham, June 15, 1880.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Sceretary.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 21st...Aëronautical Society (at the House of the Society of Arts), 8 p.m. Reading of Papers and Discussion. Exhibition of Models.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Tuesday, June 22nd...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 3 p.m. Concert by the Scholars of the National Training School for Music.
Folk Lore Society, 22, Albemarle-street, W., 4½ p.m. Annual Meeting.
Statistical, Somerset-house-terrace, Strand, W.C., 3 p.m. Annual Meeting.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. Peter Bemridge, "The Aborigines of Victoria." 2. Prof. W. H. Flower, "A Collection of Crania from the Fiji Islands." 3. Rev. Lorimer Fison, "Land Tenure in Fiji."
Royal Horticultural, South Kensington, S.W., 1 p.m.
Wednesday, June 23rd...Geological, Burlington-house, W., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Capt. R. F. Burton, "The Ethnology of Modern Midian."
Thursday, June 24th...Antiquaries, Burlington-house, W., 8½ p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6½ p.m. Annual Meeting.
Friday, June 25th...Royal United Service Institution, Whitehall-yard, 3 p.m. Mr. J. K. Laughton, "Naval Promotion, Arithmetically and Historically Considered."
Quekett Microscopical Club, University College, W.C., 8 p.m. 1. Mr. W. H. Gilburt, "The Histology of Pitcher Plants." 2. Dr. Patrick Manson, "Further Observations on *Filariæ*."
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Prof. Bentley, "The Functions of Plants and their Organs of Production." (Lecture VIII.)
Saturday, June 26th...Physical, Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner-circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,440. VOL. XXVIII.

FRIDAY, JUNE 25, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with sec. 40 of the Society's Bye-laws :—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31ST, 1880.

Dr.

	£ s. d.	£ s. d.
To Cash at Messrs. Coutts and Co., 31st May, 1879	455 8 3	
Do. in hands of Secretary	8 3 10	
		463 12 1
,, Subscriptions received during the year from Members and Institutions in Union	6,005 8 0	
,, Life Donations	567 0 0	
		6,572 8 0
,, Dividends and Interest		626 5 8
,, Examinations: — Prince Consort's Prize (H.M. the Queen)	26 5 0	
Fees, &c.	110 5 1	
		136 10 1
,, House & Office (receipts for gas, &c.)		50 17 3
,, Advertisements		1,604 2 1
,, Sales :—		
Cantor Lectures	8 5 7	
Domestic Economy Reports	2 3 11	
Journal	135 9 9	
Public Health Conference Reports	35 14 8	
Spoiled Post-cards	1 0 0	
Transactions	1 17 0	
		184 10 11
,, Donations to Artisans' Reports Fund (Paris Exhibition, 1878)		6 0 0
,, Watherston Prize (by Mr. Watherston)		100 0 0
		£9,744 6 1

Cr.

	£ s. d.	£ s. d.
By House and Premises :—		
Rent, Rates, and Taxes	336 18 4	
Insurance, Gas, Coal, House charges, and charges incidental to ordinary meetings	245 7 0	
Repairs and Alterations (including new parapet and general repairs to roof and waste-pipes)	166 16 3	
		749 1 7
,, Office :—		
Salaries and Wages*	1,791 11 10	
Stationery, Office Printing, and Lithography	341 14 5	
Advertising	58 0 9	
Postage Stamps, Messengers' Fares, and Parcels	188 16 3	
		2,380 3 3
,, Library, Bookbinding, &c.		121 16 9
,, Conversazione		261 10 3
,, *Journal*, including Printing, Stamps, and Distribution		2,442 18 9
,, Advertisements (Agents and Printing)		636 18 0
,, Union of Institutions, including Examinations, Prizes, Fees, Postage, Printing, &c.	620 10 10	
Prince Consort's Prize	26 5 0	
		646 15 10
,, Conferences on Public Health and on Water Supply		258 4 5
,, Medals :—		
Albert	2 18 6	
Society's (see also "Committees")	19 16 0	
		22 14 6
,, Prizes :—		
Owen Jones	8 6 6	
Swiney (Messrs. Garrard for Cup)	100 0 0	
Watherston (H. Singer)	100 0 0	
		208 6 6
,, Cantor Lectures		218 13 6
,, Juvenile Lectures		35 18 4
,, Sections—		
Chemical	61 0 0	
Colonial	60 18 6	
Indian	86 0 0	
Sanitary	4 1 11	
		212 0 5
,, National Training School for Music (Society's Scholarships)		160 0 0
,, Committees :—		
Food	1 2 6	
General	13 1 3	
Memorial Tablets	9 6	
Musical Education	13 7 6	
Poisonous Colours	3 14 9	
Saving Life at Sea (including Medal)	44 16 0	
Universal Catalogue of Books	2 10 0	
		79 1 6
,, Annuity to Mrs. Cantor	25 0 0	
,, ,, ,, Mrs. Le Neve Foster	75 0 0	
		100 0 0
,, Artisans' Reports on Paris Exhibition, 1878		196 11 0
,, Investment of Life Donations in Purchase of £581 10s. 9d. Reduced 3 per cents.		567 0 0
		9,297 14 7
,, Cash at Messrs. Coutts and Co., 31st May, 1880	441 15 11	
,, Ditto in the Secretary's hands	4 15 7	
		446 11 6
		£9,744 6 1

* In previous years, a total of £480 for salaries was charged to the *Journal*, the Advertisement and the Examination accounts. All such charges are now included under the one head

LIABILITIES.	£	s.	d.	£	s.	d.
To Tradesmen's Bills	417	4	2			
,, Rates	45	16	8			
,, Prince Consort's Prize	26	5	0			
,, Examiners' Fees	188	4	3			
,, Examination Prizes	58	10	0			
,, Sir Walter Trevelyan's Prize	100	0	0			
,, Sections:—Colonial, Chemical, and Indian	170	0	0			
,, Protection of Ships, Prize Medal	21	0	0			
,, Albert Medal, 1879	21	0	0			
				1,048	0	1
Excess of Assets over Liabilities				7,735	0	10
				£8,783	0	11

ASSETS.	£	s.	d.	£	s.	d.
By Society's Funds invested in—						
Reduced 3 per Cent. Stock £4,044 14s. 9d., worth on 31st May, £3,943 12s. 5d., less £571 12s. 6d. reserved to meet Trusts stated below	3,371	19	11			
,, Great Indian Peninsula Railway 4 per Cent. Debenture Stock	200	0	0			
				3,571	19	11
,, Subscriptions of the year uncollected	810	12	0			
,, Arrears, estimated as recoverable	350	0	0			
				1,160	12	0
,, Property of the Society, including Barry's Pictures and Lease				2,000	0	0
,, Prince Consort's Prize				26	5	0
,, Advertisements on the Books due and in course of execution*				1,477	12	6
,, Cash at Messrs. Coutts and Co., 31st May	441	15	11			
,, Ditto on Deposit	100	0	0			
,, Ditto in hands of Secretary (Petty Cash)	4	15	7			
				546	11	6
				£8,783	0	11

* A portion of this sum is liable to charges for printing.

STOCKS AND CASH STANDING IN THE NAME OF THE SOCIETY.

	£	s.	d.
Consols	4,891	6	4
New 3 per Cents	388	1	4
Reduced 3 per Cents	4,044	14	9
United States 5 per Cent. Funded Bonds, 1871 (2,500 dollars)	509	1	3
Oude and Rohilcund Railway 5 per Cent. Guaranteed Stock	2,150	0	0
Bombay and Baroda do. do.	2,450	0	0
Canada 4 per Cents	423	0	0
India 4 per Cents	105	18	7
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Metropolitan 3½ per Cent. Stock	343	14	3
Cash on deposit at Messrs. Coutts and Co.	100	0	0

TRUST FUNDS INCLUDED IN THE ABOVE.

1.	Dr. Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five years.
2.	John Stock's Trust	100	0	0	,, ,, the Award of a Medal.
3.	Benjamin Shaw's Trust for Industrial Hygiène Prize	133	6	8	,, ,, ,, Interest as a Money Prize.
4.	North London Exhibition Trust	157	19	8	,, ,, ,, ,, ,, ,,
5.	Fothergill's Trust	388	1	4	New 3 per Cents., chargeable with the Award of a Medal.
6.	J. Murray, in aid of a Building Fund	50	0	0	Invested in Reduced 3 per Cent. Stock.
7.	Subscriptions to an Endowment Fund	431	12	6	
8.	Dr. Aldred's Bequest	90	0	0	
9.	Thomas Howard's Bequest	500	0	0	,, ,, United States 5 per Cent. Funded Bonds, 1871.
10.	Dr. Cantor's Bequest	5,052	19	8	,, ,, Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Stock.
11.	Owen Jones Memorial Trust	400	0	0	,, ,, Canada 4 per Cent. Stock.
12.	Mulready Trust	109	12	9	,, ,, India 4 per Cent. Stock.
13.	Alfred Davis's Bequest	1,800	0	0	,, ,, Great Indian Peninsula Guaranteed Railway Debenture Stock.
14.	Memorial Window Fund	345	0	0	,, ,, Metropolitan 3½ per Cent. Stock.
15.	Sir Walter Trevelyan's Prize	100	0	0	On Deposit with Messrs. Coutts and Co.

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.
The Payments set forth above have been made by authority of the Council.
The Assets, represented by Stock at the Bank of England, and securities, cash on deposit, and cash balance at Messrs. Coutts, as above set forth, have been duly verified.

B. FRANCIS COBB, H. READER LACK, *Treasurers.*
J. OLDFIELD CHADWICK, *Auditor.*
H. TRUEMAN WOOD, *Secretary.*

Society's House, Adelphi, 22nd June, 1880.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Twenty-sixth Annual General Meeting, for the purpose of receiving the Council's Report and the Treasurer's statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new Members, will be held, in accordance with the Bye-laws, on Wednesday, the 30th of June, at 4 o'clock p.m.

The Council think it well to call the special attention of Members to the above notice, and to express their hope that Members may find it convenient to attend and receive the report of th Council on the work of the Session.

(By Order of the Council)
H. TRUEMAN WOOD, Secretary.

CONCERT BY SCHOLARS OF THE NATIONAL TRAINING SCHOOL FOR MUSIC.

A concert was given by some of the scholars of the National Training School for Music, under the direction of Dr. Stainer, Vice-Principal of the School, in the Great Room of the Society, on Tuesday, the 22nd instant, at 3 p.m. Among the performers were Misses Bénard, Turner, Twist, and Messrs. Crook and Mull, who hold Society of Arts' and Members' Scholarships at the School. The Conductor of the Choral Class was Mr. Eaton Faning.

The following is the programme of the concert:—

PART I.

Chorus from "Mirella" ... { "Facciam Carole" } .....Gounod.
Soloists—Miss Farnol, Miss Jones, and Miss Cravino.
Solo Pianoforte ... { "Andante and Rondo Capricioso" } .....Mendelssohn.
Miss Bénard.
Song .....“The Better Land” .....Cowen.
Miss Turner.
Solo Violin.....“Souvenir de Haydn” .....Leonard.
Mr. Crook.
Accompanied by Mr. Percy Mull.
Song.....“Guinevere” .....Sullivan.
Miss Webbe.
Solo Pianoforte.....“Ballade in G Minor” .....Chopin.
Miss Goss.
Air .....“The Evening Prayer” (Eli).....Costa.
Miss Mary Arnold.
Trio.....“L'usato ardi” .....Rossini.
Miss Jones, Miss Gibson, and Mr. Blower.

PART II.

Concertante for Four Violins.....Maurer.
Miss Riley, Miss Ward, Mr. Parfitt, and Mr. Crook.
Song.....“Oh! that we two were maying” ...Gounod.
Miss Atkins.
Solo Pianoforte .....“Soirées de Vienne”.....Liszt.
Mr. Cliffe.
Duet.....“Quanto Amore” (Elisir d'Amore) ...Donizetti.
Miss Maile and Mr. Young.
Solo Pianoforte.....“Polonaise in E Flat”.....Chopin.
Miss Twist.
Aria.....“Infelice” .....Verdi.
Mr. Blower.
Canzonet.....“My mother bids me bind my hair”...Haydn.
Miss Cox.
Chorus.....“Climbing over Rocky Mountain”.....Sullivan.
Soloists—Miss Gibson and Miss Hudson.

MEDALS.

The Council have awarded the Society's Silver Medal to the following readers of papers during the Session 1879-1880:—

To Major-General H. Y. D. Scott, C.B., F.R.S., for his paper on "Suggestions for Dealing with the Sewage of London."

To A. J. Ellis, F.R.S., for his paper on "The History of Musical Pitch."

To John Sparkes, for his paper on "Recent Advances in the Production of Lambeth Art Pottery."

To Henry B. Wheatley, F.S.A., for his paper on "The History and Art of Bookbinding."

To W. Holman Hunt, for his paper on "The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters."

To Thomas Fletcher, for his paper on "Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes."

To John C. Morton, for his paper on "The last Forty Years of Agricultural Experience."

To Prof. Heaton, F.C.S., for his paper on "Balmain's Luminous Paint."

To Captain Abney, R.E., F.R.S., for his paper on "Recent Advances in the Science of Photography."

ANNUAL CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

Friday, June 11, 1880; the Right Hon. James Stansfeld, M.P., in the chair.

The Chairman invited discussion on the 4th sub-head, namely, the "Administration and Organisation of the Local Government Board." He said this was a subject of considerable interest, but need not occupy them long, especially as there would be a good deal of discussion most likely on some of the later parts of the programme.

Dr. Bond said he would propose a resolution, which would enable the sense of the meeting to be taken on this matter. He ventured to suggest that this proposition went too far in one direction, and hardly far enough in another. Taking the two subjects under which class "A" presented itself, viz., areas and inspectors, it seemed to him it would be impossible to lay down any definite area until you had decided what was the work to be done. You must first determine what the inspectors had to do, and, secondly, the facilities of locomotion, which was itself a very important element in the question; and upon that you could determine the area. The real point was this, that the area should be as large as was compatible with the work being efficiently done. With reference to the second point, the suggestion of a staff of inspectors, this was moving in the wrong direction. They did not want more inspectors under that name, for though it was true the work to be done was a work of inspection, it seemed to him it would be inexpedient to increase inspectors as such, because they had already at their disposal a machinery which was ample, if properly organised, to do all that the resolution contemplated. You, had in the Medical Officer of Health, a man who should be charged with the duty of carrying out the work of inspection, that work simply being to see that the public health was sufficiently looked after.

The Chairman said the work of inspection under the Local Government Board was far more than that, it included the inspection of workhouses, and of all local government operations, not merely those directly implying questions of health.

Dr. Bond said he thought the discussion was limited to the subject of health.

The Chairman said, from the time the national health first became a matter of public attention, a number of Acts had been passed, which were called Sanitary Acts, but to some extent that was a misnomer, they were Local Government Acts, relating to paving, building, and many other matters. One important aspect, no doubt, was the sanitary aspect, but there was a certain amount of illogicality and unfitness in the title of those Acts. To carry the matter a little further, the Local Government Board was the old Poor-law Board, with the addition of what was formerly the Medical Department of the Privy Council and the Local Government Act Office. It superintended local government throughout the country; the urban and rural sanitary authorities and Poor-law authorities were controlled and supervised by that Board, It had certain staffs of inspectors to conduct its business, and to supervise all these various matters. It had a body of general inspectors, the old Poor-law inspectors, men with a knowledge of Poor-law administration and of local government, and then it took to itself the medical staff of the Medical Department of the Privy Council, and also the staff of the Local Government Act Office—the staff of engineering inspectors. It had now certain chemical inspectors also to conduct examinations under the "Alkali" and other Acts. The way in which the business of the Board was carried on was this; the Local Boards and Boards of Guardians throughout the country were corresponding, more or less, with the secretariat at head-quarters; you had all these inspectors

going down to deal with these Boards; you had all England and Wales mapped out into certain areas, within which there might be general inspectors, the old Poor-law inspectors permanently appointed dealing regularly with the local governing bodies within them. Besides that, there was the engineering staff, the members of which were sent here and there as occasion demanded, not appropriated to particular areas. The same thing occurred with the medical staff, they were utilised as required all over the country. This system was open to considerable practical objection. There was a want of organisation in dealing in that way with these several bodies of inspectors, and there was the danger of a certain amount of friction. He looked upon the Local Government Board as a great administrative department, as the central office of a business which had branches all over the country. He thought there was a great deal too much correspondence, for he believed in dealing with men through men, and his notion of the proper organisation of that department was something of this kind. He would divide the country into a smaller number of larger areas for the purpose of inspection, and in each of those without increasing the staff at all, he would classify them differently. He would have a large area under a chief inspector, who should have assistants to do the ordinary drudgery work of inspecting workhouses and so on, and a medical inspector, and an engineering inspector. He would, therefore, have a complete inspectorial staff for a large area, and would follow up the same principle in the Local Government Board itself. He would, if he could, have a permanent administration at the head of the Board, who should not be a secretary, and who should never put pen to paper, but whose business should be to conceive and perpetuate the policy of that Board, and to deal with men. He would have the head of the Medical Inspectorate to consult with, and would make a kind of Board from the heads of the Medical Department, the Engineering and the Poor-law and Legal Departments; and in that way, a system of policy would naturally grow up within the Local Government Board itself, and you would end by immensely reducing the friction and correspondence, and would give a much greater sense of independence and responsibility to local authorities, at the same time retaining sufficient hold on them from the centre for all good purposes. The meaning of the proposition put in type, was intended to be what he had just been expressing. In 1878, there were certain criticisms passed on the Local Government Board, which he thought were not altogether just, and he then went into this question, and propounded at considerably greater length than he had now done, these administrative ideas. He had great confidence in them because they had not been taken up hastily, and he had never found himself disposed to modify them during the many years he had had for quiet reflection since those days of official life when they were first formed. At the same time, he did not care to urge this part of the programme on the meeting; he could not expect every man to be prepared with an opinion on this subject at the moment, though as far as he was concerned, it was the outcome of many years' experience, and many more years of thought, and if it recommended itself to the mind of the Conference, he should be glad.

Dr. Bond said they were much indebted to the Chairman for the explanation he had given. He had not contemplated that the proposition had so large a bearing, but rather looked upon it in relation to Section B of the first clause. There could be little difference of opinion as to the desirability of the scheme the Chairman had sketched out, for everything which tended to diminish friction between the central and local authorities, must be beneficial. The more you could get local authorities to see that they were doing their work without being subject to espionage, which inspection necessarily involved, the better. So far as inspection was concerned, under the general working of the Central Board, there could be no difference of opinion as to the desirability of such a plan of organisation as had been sketched out, but that did not seem to him to meet exactly the weak point which existed in the present system, namely, a want of officers, who should come more frequently in direct relationship with the local authorities, and who should not be inspectors more than was absolutely necessary. As to the work involved in questions of public health, which was mainly of a medical character, there was no alternative, but that some medical man should have charge of it, and that was now done by the Medical Officer of Health, and he thought that the work required could be done by a proper organisation of the present Medical Officers of Health. In the first place, with reference to the office itself, there was a good deal of work which was not done at present that might be done by the Officer of Health, and a good deal of work which was done now, with which his office came into intimate relation, but with which he had no connection. For instance, one of his main functions was to prevent the spread of small-pox, and yet he had no relation of any kind with that most important matter, vaccination; he had no official relation to the vaccinators, and practically he knew nothing about it. Then, again, the supervision of factories and schools was really medical work, which was done by officials in some cases, but not so efficiently as it ought to be, and that ought to be superintended by the Medical Officer of Health. Then, again, there were the "Dairy" clauses of the Contagious Diseases (Animals) Act; that was work which in most counties was not done at all. In his own county, the magistrates had passed an impracticable resolution, and shunted the thing over to the hands of the sanitary authorities, without giving them any instructions. Then, again, there was the case of unregistered deaths which was not under any one's supervision at present, and over that work the medical officer ought to have cognisance of some kind. There were other matters, such as questions of dietary and so on, where inquiry and reports were necessary, which might be entrusted to the same officer. If he were properly qualified, he should be up to all branches of his work; and he would suggest, with a view to increased efficiency and economy, that it was desirable the machinery for the protection of public health should be placed on a more satisfactory footing than it was at present. He referred especially to the position of the Medical Officers of Health. Nothing could be more unsatisfactory. At the present time, they were appointed temporarily, and liable to continued reappointment, and were, therefore, not independent, and were not placed in such a position as to free them from that collision between their own private interests and the public interests, which ought not to exist in the case of public officers.

The Chairman said the point Dr. Bond was discussing, namely, the position of Medical Officers of Health, would have come more naturally at an earlier part of the programme. He did not think it would be right, on his part, to ask the Conference to come to any distinct and strong expression of opinion in relation to sub-section *a* and *b*, under subhead 4, but they were really the outcome of his experience, and the expression of what he had said at previous Conferences, and the whole matter would be found largely expounded in the report for 1878, page 31. All that occurred to him was that the Conference might be inclined to pass a resolution to this effect:—"That, in the opinion of this Conference, the question whether the administrative organisation of the Local Government Board should be strengthened and improved (*a*) by mapping out England and Wales into a few large areas, &c., following the words of the programme, and (*b*) by instituting an Inquiry Department, &c., is one deserving of the atten-

tion of her Majesty's Government." All they would then be doing would be to intimate that they had had explanations of that subject, and thought them worthy of consideration.

Mr. Edwin Chadwick, C.B., said—I cannot be present without making some observations on the question before the Congress over and above the immediate question raised as to the direction of local inquiries by inspectors; there is the subject of distinct and serious inquiry which will have to be made elsewhere, as to the constitution of a competent deliberate authority by whom such inquiries may be directed, and by whom the results obtained shall be deliberately studied, and competently and responsibly applied. The existing arrangements tend only to ensure deficient deliberation and perfunctory and unsatisfactory action. We have a Board talked of, composed of all the highest officers of State, the Lord President of Council, the Secretaries of State for the Home Department, the Colonial Department, and the War Department, the Lord Privy Seal, and the Chancellor of the Exchequer. But such a Board has never existed and acted in reality. On a due examination of the outcome, it will be found that the default has not been merely one of form, but has been attended by the most serious consequence in substance. To illustrate these existing conditions of the action without any central Board, I may accept the qualifications assigned to me, in dedications of works, by distinguished officers who served with me, and that I have a competent mastery, at least of those administrative principles which I have elaborated, and that events have vindicated. Now, suppose I were a president in Parliament, and had, moreover, the honour to be a cabinet minister, and in that high capacity as a minister, parliamentary affairs on all sorts of disparate subjects, foreign as well as domestic, to attend to at night as well as by day; the deliberate attention required for the work of the department must be frustrated and dissipated, and I must needs rely on the inspirations of the secretary, and then the heavily overburdened secretary must needs rely on clerks, and these clerks, instead of having to work up to superior, leisurely, deliberative authority, and undivided competent attention, have to work in haste, and with apathy or antipathy to responsibility. The outcome of these conditions will be seen in one branch of service, the administration of relief to the destitute. Under the first real Board of competent officers, giving undivided attention to their work, fundamental improvements were made in the administration, and, with all shortcomings, the burthen of the rates was reduced by nearly one-half. But, under the existing conditions, abuses reappeared, and the burthen was again doubled. The retrograde progress has been checked by local reaction, and by local Conferences of Boards of Guardians to obtain that information which the action of the original deliberative authority gave to them. Take the great sanitary branch of the service of the department. During the first five years of the action of a real deliberative authority, the first General Board of Health, fundamental sanitary principles were laid down, such as have not been added to, or deviated from, without detriment, and examples of large direct reductions of death-rates were obtained in a number of towns, and extended action on those principles promoted in other places. Advanced normas of sanitation were established for general application. But this sanitary service has been merged with other functions, and placed, not in the principal position due to it, but in a position secondary to the mass of other functions heaped upon that Board. For twenty years, some twenty-seven thousand pounds a year has been expended upon the Medical Department; about double the expenditure upon the first deliberative authority, the first General Board of Health, the Sanitary Engineering Department included. And what has been the outcome to be shown for that double expenditure? I have inquired for an example of its direct action, and I cannot learn of one instance of a town or place where a death-rate can be shown to have been reduced by it; and the reduction of death-rates is the only real test of the efficient expenditure of the public money. You will apparently only find traces of its action against one epidemic, which is only of about the fifth magnitude, namely, the small-pox, and that action very incomplete. And what position has it, as compared with the first General Board of Health, either in this country or in Europe? One officer of the Local Government Board, has in his evidence expressed his fright at the increase of local burthens for works; and returns may be called for of the sanction of expenditure for separate works that have proved to be unproductive, with the view of seeing on whom responsibility now attaches for misfeasance as well as for non-feasance. In the first General Board of Health, the administration had the primary qualities of all correct administrative organisation. The management was transparent, and the ostensible was the real and the responsible; and there will be only halting and inferior local progress and reduction of excessive local burthens, with unproductive expenditure, until action upon correct principles is restored.

Mr. Alcock hoped that the Conference would adopt the Chairman's suggestion with regard to the sub-section, so that attention might be called to the desirability of considering the question. He did not know that it would be competent to them to go much further, because he doubted whether they had sufficient information to enable them to do so. It was a large question, which must be considered by those who were acquainted with all the workings of the Local Government Board itself. On sub-section *b*, there ought to be no question of passing a very strong resolution in support of it. The local authorities throughout the country had found, from time to time, very considerable difficulty in carrying on their duties with reference to the great expense they were put to in trying to find out the best means of carrying out their sanitary and other administration. They got no assistance from the Local Government Board, because, if they assisted, they felt they would be taking the responsibility of the success or failure of the course recommended. But they might assist local authorities materially by an inquiry department such as we have sketched out. He thought all the information they got from year to year should be furnished to each sanitary authority, whether they asked for it or not. He would beg leave to move the resolution.

Mr. Owen asked whether the tendency of sub-section *a* did not go towards increasing rather than diminishing Imperial centralisation.

The Chairman said certainly not; at present there were a larger number of areas than were contemplated in his statement, and a larger number of general inspectors, dealing more in detail with the operations of the local authorities than he hoped it would ultimately be necessary to do. His notion was to diminish inspection in detail by enlarging the areas, and practically, therefore, restricting the representative of the Imperial department to larger lines of action. If, instead of having a Local Government Board inspector over one county, they put him over three, and gave him a subordinate to do the mere drudgery, that man became a bigger man, he dealt with larger questions, and became more of a negociator instead of an inspector, and that was what chief inspectors ought to be. He had sometimes called them the diplomatic representatives of the Local Government Board to the Local Boards. These functions might be considered as *quasi*-diplomatic, or, to use another figure of speech, he had sometimes called them

the managing partners in a given part of the country of a great business which extended over the whole of the country. The whole object and meaning of the proposition expressed in sub-section *a* was to restrict the habit of a necessarily minute and tedious inspection.

Mr. Owen said that would go to diminish the number of inspectors, but not the amount of inspection.

The Chairman said it would practically reduce the amount of inspection. You would increase the powers of inspection in some cases, as, for instance, in the cases of disease. Instead of sending down suddenly an inspector, when fever sprang up in a particular locality, according to this scheme, you would have a considerable area of country under a staff of inspectors, one of whom would belong to the Medical Department, and his function would be to watch the progress of health in that area, and without waiting for an outbreak of fever, to indicate where there was a weak point in any portion of that great area. One great advantage of this kind of arrangement would be, that in each area you would have again a little Government Board *in petto*; in each area you would have a general inspector, whom he would elevate and make a man of policy rather than of detail; at the centre he should repeat the same kind of organisation. He should desire to have a permanent head, calling him a vice-president rather than a secretary, and he would manage the whole thing, not as matter of correspondence, but as a matter of business. No business man did anything by letter which he could do by word of mouth. The function of correspondence was rather to record results arrived at. He believed in dealing with men through men, and that such an organisation as he suggested would be a vast improvement from that point of view.

Dr. Bartlett said he thought on sub-section *a* there would be very few dissentient voices; and, no doubt, a large number of persons who have considered the question must have come to something like a plan in their own minds somewhat similar to that now put forward. He thought the only way to deal with the matter was to have a certain number of directors, and that they should direct the technical inspectors, whether medical or engineering, or whether merely dealing with the details of the work to be done. You would then, if the whole of the country were mapped out in these large areas, do the work with much less friction, and give a much larger amount of responsibility and power to those who were to take these subordinate positions on these so-called Boards. He believed the whole business of the country would then centralise itself in the Statistical Department at head-quarters. That practically led you to sub-section *b*, because the Statistical Department, which would be the head-quarters of the Local Government Board, would have at its command details such as were not available to them or to any of the Local Boards at the present moment. But here came a point on which he should like to have a little information. The programme used the words, "For the assistance of local authorities wanting information and applying for it." He thought, however, if it were to take the form of monthly, quarterly, or half-yearly reports, and they were supplied to all the heads of large areas, and through them distributed again to the smaller sections, there would be no necessity for them to apply, because it would be at their fingers' ends. But then came another part on which he felt some doubt, namely, "charged with the investigation of scientific processes." There he should conceive that a great benefit might be arrived at, but, on the other hand, if this were not dealt with very carefully, it was quite possible the investigation of scientific processes, which mainly meant, he apprehended, the dealing with sewage matters, and so forth, in connection with sanitary affairs, and perhaps including the disinfection of hospitals, might perpetuate a Government monopoly with regard to the purity of the water supply. What was the result at the present time, of that which was considered to be a Government statement of the water supplied even to the metropolis? Dr. Frankland had adopted a process of analysis of his own; he did not even give in his reports the detail of any process of analysis, but took an ideal standard of purity of one water, and compared all other water supplies with that particular sample. He said you had moving organisms in it, and that it was impure, but a microscope in the hands of almost anyone would give equal information; and when he said the amount or organic impurity amounted to so much relatively of one water as compared with another, that again afforded very little information, because he did not give an idea of the total organic impurity in any water. He mentioned that merely as a matter of great importance when considering the investigation of scientific processes. If they were merely to have a Government office, with a number of chemists attached to it, who, from Dr. Frankland's standpoint, recommended a standard of purity, and one process that might be just such another as that of purity in water, which should give no indication of the real value of the processes whatever. In the same way, Dr. Tidy brought forward another process. He had erected two standards of purity, and of each of them he had given details, both with regard to water supply, and also with regard to the purity of gas. Gas inspection, again, was anything but a success, and there was little to warrant any great dependence on these plans of inspection of scientific processes. He was afraid this was a point which would have to be considered in detail before they could arrive at any unanimity, and he would, therefore, suggest that it be left for further consideration.

The Chairman suggested that Dr. Bartlett's difficulty might be met by omitting the words, "charged with the investigation of scientific processes."

Mr. Alcock thought it would be a pity to do that.

Dr. Bartlett also suggested the insertion of the words "distribution after publication" in the last paragraph.

Mr. Donville said men required to be educated against their wills, and it was desirable that information should be sent to County Boards whether they applied for it or not. It often happened that a large scheme of sewage was left undealt with because there was no information as to which system should be adopted. It was often made an excuse by Local Boards that the expense of obtaining such information, and the difference of opinion amongst experts was so great, and also that there was no place to which they could apply for definite information. Therefore, he thought the reports should be distributed gratis.

Mr. Adolphe Smith wished to ask Dr. Bartlett whether the analysis by Dr. Frankland or Dr. Tidy was not withheld from the public for the sake of brevity, and whether if any medical man or scientific man taking an interest in the matter were to apply, they would not have full and complete information given. He thought the Government ought to be entrusted with the investigation of scientific processes, but he agreed with Dr. Bartlett that it should not be made a monopoly, and that the system of such investigations should be open to the broadest inspection, the fullest criticism, and the greatest possible improvement.

Dr. Bartlett said he had no doubt that, in courtesy, Dr. Frankland or Dr. Tidy would afford any Medical Officer of Health such information privately as they might ask; but that on that which was published, and from which all the world formed their own ideas, they were left in the dark as to the means by which those statements were arrived at.

The Chairman thought it would be advisable to omit the words "investigation of scientific processes," for this reason, that on reconsidering the terms of this para-

graph he did not think they came in very well there. The department proposed was an inquiry department where people could inquire and ascertain the facts. No doubt the investigation of scientific processes must be carried on from time to time, for instance, by engineering inspectors as to methods of drainage, or water supply, but he did not think they would be conducted in what he should call the inquiry department. With regard to the proposal that besides publication of periodical reports they should include the word "distribution," his own opinion was against it, because he thought it was descending rather too much into detail to say that the Local Government Board should be bound to distribute, gratuitously, its reports to all the Local Boards throughout the kingdom. It was enough to use the word "publication," leaving the method of publication to the Board itself.

Dr. Bartlett said he only suggested it as regards those large areas, so that the reports might be accessible to those various centres.

The Chairman thought the word "publication" covered everything, and did not preclude anything.

Dr. Wilson (Rochdale) said that recently a most important investigation, with regard to the diseases arising from offensive trades, had been published as a Blue-book, but curiously enough that volume, though it would be valuable for many years to come, was out of print, and many Medical Officers who, from seeing criticisms of it, were anxious to obtain it, could not do so.

Professor Way thought sub-section *b* did not clearly point out where the inquiry department was to be instituted. It would be a central department, no doubt, but it should be so stated.

The Chairman said they might insert the words, "in the Local Government Board."

Capt. Galton, F.R.S., said there was one point connected with the arrangement of the staff of local inspectors which should not be lost sight of, viz., that the department of registration should be under the Local Government Board, and that the local registrars should be placed under these local institutions. Otherwise it was perfectly clear that the outlay of the registration did not assume its full value.

Mr. Shawcross said another point of importance was the necessity of cases of infectious disease being reported to the Medical Officer of Health. They found great difficulty in their town in ferreting out these cases. If it were made compulsory that every medical officer should report such cases, it would give them great assistance in carrying out their work.

The Chairman said the Registration Board was now under the Local Government Board, but he did not know exactly what was going on; it ought to be that that Board should now come more directly under the supervision of the Local Government Board, but it was hardly a question before the Conference. He hoped that would be the case, but he did not know what was done, or what would be done, not being familiar with the existing organisation of the Registration Department, and therefore he was not prepared to draft a resolution on the subject. He then read the following resolution, and put it to the meeting, when it was carried unanimously:—

"That, in the opinion of this Conference, the question whether the administrative organisation of the Local Government Board could be strengthened and improved by mapping out England and Wales into a few large areas—each area to be under the administration of a staff of inspectors, the whole under the superintendence of a permanent head of the department, properly assisted, and relieved of secretarial work—is one deserving the attention of her Majesty's Government; and that this Conference is of opinion that it is desirable there should be instituted, without delay, an Inquiry Department in the Local Government Board, for the assistance of local authorities wanting information and applying for it, charged with the collection of statistical data, the official record of sanitary experiments here and in foreign countries, and the publication of periodical reports upon the results obtained."

The Chairman then invited discussion on the second head, namely, amendment of the law.

Mr. Cresswell said the suggestions were not new on the part of the Executive Committee, but were in fact the carrying out, so as to include them in a Code, the suggested amendments which had been discussed, and more or less sanctioned during the last five years. It was thought desirable that all these amendments and resolutions should be codified and formulated so that they might in future turn to the decalogue—if that expression would not be deemed improper—of sanitary law, of the year 1880, and at once see all that which they believed to be the ascertained opinion of scientific men and medical officers up to the present day. They, therefore, thought it desirable to insert under the head of amendment of the law certain resolutions, which had been already sanctioned by previous Conferences, more for the purpose of codification than any other purpose. In section 299 of the Public Health Act there was a clause, which was one of the most important in the Consolidation Act (namely, the one which empowered the Local Government Central Authority to take proceedings on complaint of default by the local authority), as every one had large experience of the defaults of local authorities, and had pretty well ascertained that unless compulsion in some form were applied, morally or legally, these defaults would continue to increase. The attention of the Conference of 1878 was called to this point by Dr. Child, whom he was glad to see present. That clause ran as follows:—"Where complaint is made to the Local Government Board, that the local authority has made default in providing their district with sufficient sewers," &c., "or that the local authority has made default," and so on—these words were somewhat prolix, and were, what they called in law, the inducement; but the emphatic words in it were these—"where complaint is made." Now Dr. Child called the attention of the Conference to some cases which had come under his notice, and to a decision of the Courts, as far back as 1878, that the words "complaint made," governed the whole section, and that it was not a complaint by an inspector of the Local Government Board, or even by the medical officer appointed for the express purpose of making complaints, but that it meant a complaint by some body *ab extra*, who was not a member of the Local Government Board, or of the local authority, but an outsider aggrieved by the default of the local authority. The Courts had decided that even where their own inspector came before the Board with the gravest possible instance of a default made here or there, the Board had under that section no authority to interfere. He thought to himself that subject was worth attention, and suggested that the object they had in view might be attained by leaving out the introductory words which he had already read, and commencing with the practical part of the section, so that the clause should read as follows:—"Where a local authority has made default," &c. That seemed to him as simple a proposition as possible, and that was the real meaning of this first statutory amendment. It did away with all the difficulties and obstacles which had hitherto occurred, and had obstructed the action of the Local Government Board, where they had been desirous of doing their duty.

Dr. Bond was surprised that Mr. Cresswell, as a lawyer, had made this suggestion. He had started with an assumption without any basis. How was the Local

Government Board to know that a sanitary authority had made default without it was informed? Was it not necessary to insert the words "when the Local Government Board were informed from any source?" Unless you introduce that, how was it to be assumed that the authority had made default? But his objection to that proposition, which he thought admirable, and to the other three, which were equally admirable, was this:—That it was inexpedient to pick out four matters connected with the Public Health Act for special suggestion and amendment, when the whole Act bristled with points which equally required inquiry. It was scarcely possible to put your finger on a clause of the Public Health Act, at any rate the more important general clauses, which did not demand inquiry in view of the light obtained by experience of the last seven years. He ventured to think if the Chairman would crown the edifice, the foundation of which he had laid by bringing in that Act, by taking such steps as to press upon the Legislature the necessity of instituting an inquiry into the working of the Act generally, so far as was practicable, it would be found that not only this clause, to which Mr. Cresswell had drawn attention, but a number of others were full of difficulties, to such an extent as to make the working of the Act impracticable. He did not wish to deprecate discussion on this point, but if the Conference saw their way to a general resolution, he thought far more good would be done by passing it than simply by drawing attention to these isolated points, which would lead to the inference that these were the sole or most important ones which required amendment.

Mr. Owen desired to draw attention to a kindred question. Perfectly agreeing with the suggestion made by Mr. Cresswell, he would suggest that the Conference should go still further, and that the proposition should be applied not only to the Public Health Act, but other Acts which, at the present time, required that some individual should put the public official in motion before the Act could be put in force; for instance, the Pollution of Rivers Act and the recent Adulteration Acts. There was a very important question which had come under his own observation, with regard to enforcing the Adulteration Act, especially in regard to the adulteration of milk. The Act was practically a dead letter. To arrive at the point desired, namely, of proving the adulteration of milk, was surrounded by so many processes, and such an amount of trouble and formula that individuals could not be expected to go to the trouble of putting the Act in operation. In the first place, they had to undergo a considerable amount of expense, for the cost of analysis was something like 10s. 6d., and other details which required to be attended to, such as informing the seller that the article was purchased for analysis, dividing it into three portions, &c., were so cumbersome, that unless these were simplified it was impossible to put the Act in operation against the vendor of the article. Again, with regard to the pollution of rivers, as it at present stood, only one individual could set the Act in motion.

Dr. Tripe rose to order. He did not think this came within the scope of the discussion.

The Chairman did not think Mr. Owen was out of order. They had already had a suggestion that, instead of going through the several heads of amendment of the law, they should pass some resolution, expressing in their opinion that the Public Health Acts needed review; and he understood that Mr. Owen's remarks had a bearing on that point.

Dr. Tripe said these Acts were not to be found in the Public Health Act, which was the only Act under discussion.

Mr. Owen said his suggestion was, that the present Conference should take a general grasp of those Acts which require to be amended in a similar manner. With regard to the pollution of rivers, there was a factory situated on the banks of a river in his neighbourhood, which used a quantity of chemicals, and besides had a private gasworks; a large quantity of refuse was discharged into the river, which had the effect of so polluting it, that the fish were destroyed by bushels as he was informed; and not only so, but the sheep and cattle were poisoned by drinking the water. Being for a time resident in the neighbourhood, he remonstrated with some of the parties, and expressed a desire that the Act should be put in operation, but was met by the objection that there was no one who had sufficient courage to "bell the cat." He would suggest, therefore, that the officials should have power to put the law in motion.

Dr. Wright (Cheltenham) said there was no doubt the Consolidation Act required careful revision by practical men, and if they did not pass some general resolution, their time would be taken up by discussing details, and nothing would be done.

The Chairman said it seemed to be the general feeling that it would be possible to pass some resolution of the kind referred to; but he did not see why they should omit all reference to the subject matters dealt with at the previous Conferences. They might deal with them, and conclude with a general resolution.

Mr. Mellor (Town Clerk of Rochdale) did not think Mr. Cresswell had shown any reason why the words he proposed to leave out should not stand. Mr. Cresswell wanted to place in the hands of the Local Government Board the power of at once going down into a district and exercising jurisdiction in cases where no complaint had been made to the local authority. That was really the object of striking out those words. The object of the Legislature was that some complaint should be made to the Local Government Board that the local authority of the district was not carrying out the provisions of the Act, before any interference by the Local Government Board. He thought the words ought to stand. Why should not complaints be made to the local authority in the first place; and they ought at least to know who complained.

Mr. Chadwick said he had often known cases in which individuals came to him privately and confidentially and made complaints of the Local Board, the Local Board being composed very often of landlords owning the very worst properties to be dealt with. When he asked them why they did not apply to the local authorities, the answer was—"I am in private practice, and a good many of my best patients are members of the Board." Why were people to go on dying because you stopped every source of information, except through the local authorities. Sometimes the Local Government Board itself could see by the death-rate that there was great local maladministration. Where there was a death-rate of 20 or 30 per 1,000, it would be their duty to make inquiry into it.

Mr. Mellor did not see why the local authorities should not be supposed to have the welfare of the community at heart quite as much as any central authority residing in London. There might be exceptional cases, but it did not follow that the members of Local Boards in general were not as ready and anxious as Mr. Chadwick or anybody else to look after the public welfare. Very often when they came to the central authority (the Local Government Board) they were met by all kinds of obstructions and red-tapeism, and when they wanted to carry out certain provisions, the Central Board assumed to know a great deal more about the matter than persons on the spot.

Mr. Chadwick said the fact was, that the greater proportion of local authorities had too little knowledge of sanitary science, and had no knowledge of correct standards for its application. One of his first instructions, in sending an assistant Commissioner to inquire into complaints of this kind, was to take the local authorities

with him to the seat of the fever, and very often those local authorities, mayors, or town clerks, when they saw the places in question, were perfectly astonished at the conditions existing there without their knowledge, and never could have believed that anything of the kind could have existed in their town.

Mr. Mellor said that was, perhaps, not to be wondered at, after what they had heard the previous afternoon, of the numerous cesspools which existed under gentlemen's houses, even in London.

Capt. Galton thought, in face of the resolution passed yesterday suggesting the increase of areas to the county area, it would be more prudent to adopt Dr. Bond's suggestion of a more general resolution. If they had an improved organisation, generally many of the arguments for direct interference by the Central Board, without the interposition of some local authority, would fall to the ground, and it required great consideration as to how far it would be expedient to suggest that the Local General Board should directly interfere without official application from some person interested in the district to require the removal of a grievance. There was no doubt that people now complained somewhat of a certain amount of interference, and that would be increased to a considerable extent, especially if inspectors were to go about the country to find out for themselves the various defects which might exist.

The Chairman said there was some ground for the proposal of Mr. Cresswell, for he knew from his own experience that there were cases where the interference of the Local Government Board was highly to be desired, and where the governing body of the locality and the inhabitants themselves seemed to be in a conspiracy to injure themselves. Of course that interference ought to be as small as possible, and only taken under every precaution. But there were cases where there seemed an impossibility of taking action against local authorities, who were wilfully and perversely refusing to look into the matter, because a person could not be found to make information and complaint. If they had a system of inspection—not vexatious inspection—in the interest of the national health, it seemed preposterous that they should report that that national health was being damaged by the neglect of the local authority, and yet not be able to take any action. It would be, no doubt, unadvisable that the Local Government Board should often have to act on this report without some complaint from an inhabitant, but the answer to that was, that the cases were very rare.

Mr. Alcock hoped the Conference would not pass a general resolution, because that would amount simply to this, that the Public Health Act required amendment. That was such a self-evident proposition, and would be to the end of time, that it would have no effect whatever. Unless the Conference believed it was possible to obtain a perfect Act of Parliament, the Public Health Acts, whatever they were, would infallibly require amendment from time to time, and they had far better confine themselves to specific amendments which they could agree upon, and bring them to the attention of the Government, and then, whenever the Public Health Act was required to be amended, urge that those particular amendments should be introduced. One other amendment had occurred to the local authority in Sunderland, and that was with reference to the 252nd section of the Public Health Act. That enacted, that any complaint or information, made or laid in pursuance of this Act, was to be made or laid within six months from the time when the matter of such complaint or information arose.

Dr. Bond said, if they were going to accept suggestions from gentlemen present as to the points in which their authorities considered the Act required amendment, they would never get to the end of the business. If they were going to discuss all these points, well and good; but his suggestion was that, in addition to that, they should pass a comprehensive resolution, and he had not yet heard any satisfactory reply to that suggestion.

Mr. Alcock said he thought, perhaps, further amendments were a little out of order; but as one speaker had been allowed to address himself to the Adulteration Act, he certainly thought it was open to him to bring forward another amendment with reference to this particular section.

The Chairman said the first question was, whether they proposed to go through the sub-heads of the section headed "Amendment of the Law," and come to conclusions for or against those suggestions, or whether they would prefer to substitute some general proposition. Mr. Cresswell had suggested to him a modified course, that they should pass the resolution in general terms, but should append to it those matters indicated under head 2, as matters deserving attention, without absolutely committing themselves to specific resolutions. The resolution would then run in this form:—"That, in the opinion of this Conference, the Public Health Act, 1875, and Pollution of Rivers Act, 1876, require revision and amendment in many important particulars, and that the suggested amendments and additional clauses subjoined deserve the attentive consideration of Parliament;" and then bring in that second head of Amendment of the Law.

Dr. Wright said that was a form of resolution he was going to have suggested.

Dr. Bond suggested the addition of the words:—"In such other Acts as deal with the subject of public health" that would include the "Adulteration Act," the "Contagious Diseases (Animals) Act," and other Acts which dealt with the public health, wholly or partially.

Mr. Cresswell asked if Dr. Bond was prepared to guarantee morally that those other Acts did require amendment. He had not studied those Acts, and, therefore, could not give an opinion; but if Dr. Bond had done so, and could give that assurance, he had no objection.

Mr. Nicholls, C.E. (Birmingham), said he had had an experience of some 30 years in this matter, and one of the greatest difficulties found was that the present Acts worked one against the other, and the only proper course would be to get a new Act of Parliament entirely embodying what they had at present, with some modifications. As it was, the clauses cut one against the other, and legal men could agree upon nothing. When they got County Boards properly constituted, and especially if they got public inspectors, a great deal would be done.

Dr. Tripe thought no general resolution would be of any use. The only way was to pick out definite evils, and keep on hammering away at them until they were altered. He was astonished at Dr. Bond, with his experience, proposing to pass a merely general resolution. They had better keep to the Public Health Act, and not go into the question of food adulteration and other matters. He knew as well as most the evils of food adulteration, for amongst other things he was a public analyst, but it seemed to him perfectly useless to go into these questions; they ought to confine themselves to the Public Health Act, and point out certain specific matters which required alteration.

Mr. Day (Reading) agreed with the last speaker. There was no doubt the Act required general amendment. With regard to sub-section *b* of the agenda paper, which dealt with sewers and house-drains, he should be prepared to contend, at the proper time, that the section referred to there would give the local authorities scarcely any more power than they at present possessed; on the other hand, there was another of the Metropolitan Acts which contained pro-

visions which, if inserted, would give almost every additional power which could be wished; he referred to the 18 and 19 Vic., cap. 120, an Act for the better local management of the metropolis.

The Chairman said he should like to get the opinion of the Conference on this question. Was it the wish to deal with section 2 (Amendment of the Law) in the manner proposed? that was to say, point out certain proposed amendments as worthy of consideration, and then attach to it a general resolution. Then they must go through the various special amendments named, and see if they were agreed upon them. First came sub-section *a*, giving the Local Governent Board the power to act even without information and complaint by the inhabitants of the locality. Upon that there was a difference of opinion, and, as far as he was concerned, he agreed it would be bad policy on the part of the Local Government Board to take that course, if it could take any other, and no President of the Local Government Board would ever consent to do it except in the last resort. Still, it appeared illogical to give a power of supervision, and create a staff of inspectors, who should make reports on which the Local Government Board could not act. He did not think there would be any of the dangers Mr. Mellor had suggested.

Mr. Story (Mayor of Sunderland) did not at all agree with the proposed amendment mentioned in sub-section *a*. At the first blush he was disposed to accept it, but on consideration he did not believe it would work well. What was the principle they had laid down? It was that the local authorities should be left to manage their own affairs as far as possible, and that the imperial authorities should not take any action of its own until there was a clear necessity arising for it. The effect of this proposal was to depart from that principle. The Chairman said he did not think the President of the Local Government Board would be disposed to get into hot water, and if they always had a president of the same judicial mind as himself, that might be so, but it was not the president they had to do with, it was a crotchety inspector, or to put it in another form a too scientific inspector, who saw things he thought ought to be done, and the local authority had left undone, and who, out of his deference to theory and science, insisted on an inquiry. He quite admitted there might be special instances, such as had been mentioned in outlying districts, where it might be difficult to get persons to complain, but in ninety-nine cases out of a hundred where there was a necessity, you would find some one ratepayer who would make a complaint to the authorities. They only required that he should write a letter, and the fact that he had written a letter and made a complaint under the present law, gave a right to the central authority to deal with the question.

Dr. Tripe asked if the objection would not be met by substituting the word "information" for the word "complaint." It was the latter word which created the difficulty.

The Chairman asked if he would include the information of the inspector.

Dr. Tripe said he would leave the clause as it stood, substituting "information" for "complaint." There was a great difference between the legal definition of the word "complaint" and "information."

Mr. Parrish said, under Section 114 of the Act relating to offensive trades, the local authorities were bound to take proceedings on the certificate of their Medical Officer for Health, or a complaint by any two legally qualified medical practitioners, or by any ten inhabitants of the district to such authority. It seemed to him if this clause were inserted, allowing any ten inhabitants to make the complaint, it would meet the difficulty.

Dr. Vacher said that was going back, because a single person could do it now.

Mr. Cresswell asked if it was likely there would be any two medical men in any country district who would go and make a complaint.

Mr. Shawcross said the last suggestion would limit the Act still further, for at present it gave the widest power to any person to make complaint.

The Chairman said he would now put the question of omitting sub-section *a*. The proposition was to enable the Local Government Board to institute an inquiry on the motion of one of its own inspectors, and it was objected by some gentlemen that there was no sufficient practical difficulty to justify this change in the law, and that it would be received by the local governing bodies as rather an invasion of their own independence, and would tend rather to make the administration of the law uupopular. There was a good deal in that argument, and, as far as he was concerned, he would give the general advice not to pass a resolution on any subject, if they could only pass it by a small majority.

On being put to the vote, it was decided to omit reference to sub-section *a*.

Mr. Cresswell then brought forward sub-section *b*. He said this was practically Mr. Alcock's resolution, which was thoroughly well ventilated and discussed two years ago, and, as far as he could judge, received the unanimous sanction of the then Conference. He trusted they would be able to carry the resolution for an amendment of the law, which, in the opinion of almost every practical man and engineer, was highly desirable. The Legislature had already recognised in the City of London certain powers, which were, by the statute referred to, conferred on the Commissioners of Sewers, and there could be no fear in the case of the City of London that so powerful a body would allow their municipal or individual liberties to be infringed; if for nearly a quarter of a century the Act had worked well there, they had a right to assume it would work well throughout the whole country. It seemed to come to this. The duty of the local authority, as it was the duty of the Commissioners of Sewers, was laid down clearly by the Public Health Act. They must construct sewers, and deal with the disposition of sewage of the district or town: but the difficulty arose when you came to apply the provisions of the Act to the many cases where you had to make the connections with private houses, either adjoining the road, or at some little distance (according to the Act of Parliament within 100 feet), *i.e.* make connection with the domestic drains of each individual property. In many instances in the metropolis which were known to all (he would not mention the name of the street), but in a street where even a Prime Minister condescended to live, for 40 years there was no connection whatever. The sewer ran down the main street, and the occupiers of the houses, immediately contiguous, had omitted the simple precaution of connecting their drains with it. It was not until typhoid fever, that inevitable exponent of evil, discovered the result of 40 years' neglect, that any steps were taken, and the result was that five years ago a new sewer was laid down. He knew another most important street where the same operation was now going on. Had this street been under the immediate surveillance of the Commissioners of Sewers of London, or anybody empowered to deal with the question in a similar way, this never could have happened. It was proposed that the connection between the house drain and the sewers should be made under the inspection and by the authorised contractors of the same body which constructed the sewers, and it would be done for the same objects, and at the same time that the houses were built or the sewers constructed, at the expense of the proprietor, or, in some cases, of the towns or districts. It would be done by authorised men under the inspection of persons qualified in every possible way to determine that ques-

tion, which, after all, was most important, viz., that where you had a common sewer, the connection between that and the house drain should be made the means of carrying away the refuse of the house, without incurring the terrible risk of carrying disease and death into those houses themselves.

Mr. Adolphe Smith rose under the painful impression produced by the rejection of paragraph *a*, for he feared that, having defeated the first clause, it would be very difficult to put into execution paragraph *b*, now under discussion. It was precisely the local authorities who would, in many instances, fail to take upon themselves these active measures. It was the small Local Boards and parish authorities, who were composed to some extent of those owners of property, who were the greatest transgressors against the sanitary laws. If you went about the City of London, you could find a startling illustration of this fact. In London, there was the Common Lodging-houses' Act, which was carried out not by any local administration, but by the police, and these common lodging-houses were, perhaps, the most sanitary places in the whole town accessible to the poor. Side by side with them, you had houses let out as private lodgings to poor tenants, where the most abominable state of things prevailed. Why was it the common lodging-houses were well looked after, whilst the private houses were neglected? Because in one case there was a central authority which interfered, and in the other case the private houses represented private influence in the District Boards, and it was therefore impolitic to denounce the sanitary condition of many of these places. Local medical officers denounced at a moment's notice anything which went wrong in a common lodging-house, and the inspectors were constantly visiting them, but in the private houses it was not so. It would be very well to pass the resolution, but it would not be of much use unless you could ensure that local authorities would do what was proposed.

Dr. Wright did not think the Conference ever passed a more important resolution than that of Mr. Alcock, on the 24th May, 1878, for every one practically acquainted with the working of the health of towns knew that the mischief did not arise with the public sewers, which in general had been well made, but from the imperfect communications between them and the private houses, because there was no power to compel owners of property to have a proper inspection of them when the work was being done. Consequently, it was done underground, and no work was so dreadfully scamped as that which was soon covered up by two or three spadesful of earth. The result of this omission was that, after a year or two, persons who thought their houses were thoroughly drained, found when they were laid open that everything was wrong. A friend of his, a medical man, lately built himself a house, but there was no efficient inspection made of the sewers and drains, and everything went wrong. Another case lately came under his notice, where a case of diphtheria occurred to a girl who had been attending a school attached to a training college, and after her death the floor was taken up, and a large 12-inch drain, un-socketted, was found underneath, from which there was a constant pollution of sewer gases. All these things showed that there ought to be a power of inspection by the sanitary authority, to look after the connection between the sewers and the houses. From his experience in his own town, he could repeat case after case what had been so well described by Mr. Eassie with regard to the drainage of London.

Dr. Vacher said he would move that paragraphs *b*, *c* and *d*, be accepted *en masse*.

Mr. Chadwick said that in London the excess of deaths above a low healthy standard was upwards of 17,000 annually; but he believed that, if the provisions of the Common Lodgings Act were extended to all tenements let out at weekly rents, as might fairly be done—as, from their changing population, they were in fact common lodging-houses—they would be immensely benefited, and a most marked reduction would be effected in the excessive general death-rate.

Dr. Yeld seconded Dr. Vacher's motion.

Mr. H. H. Collins opposed the resolution, because be thought, so far as the metropolis was concerned, it was scarcely required, and neither would it meet all the evils. He knew a case of a new house where the drain, through the basement, was a perfectly secure drain, covered with paving stones, which formed the floor of the basement passage. In progress of time the cement dropped through, and the sewer gas was immediately poured into the house. In such a case, the more perfect the connection with the sewer, the more certain would be the entrance of the sewer gas into the house.

Dr. Vacher said, under those circumstances, there would be a nuisance on the premises, and a notice could be served on the owner or occupier to abate it.

The Chairman said the Commissioners of Sewers had very extensive powers; they had full power to deal with a nuisance in the house itself, but that was not the object they had then in view. He should propose, however, to make a verbal alteration and substitute "not less extensive than" for the words "as extensive" in paragraph *b*.

Mr. Collins said that by the 72nd section of the Local Management Act the powers of the Metropolitan Board were quite as large as those of the Commissioners of of Sewers. It said that no house should be inhabited and occupied until it had been approved by the local authority. The misfortune was that the local authority neglected to enforce the obligation which the Act was passed to carry out.

The Chairman said they were dealing with the Public Health Act, and the metropolis was not under that Act. Moreover, it was important that they should go on the same lines as Mr. Alcock's resolution of 1878.

Mr. Storey said he did not intend to divide the Conference on this point, but he must enter his protest against sub-section *e*. He was in favour of local authorities having power to make sewers, and ensure sufficient water supply to all houses in their district; but he protested against the proposed method of making these particular owners or occupiers pay special rates for the purpose. The reason set forth in the paragraph was, that the cost should fall, as far as practicable, on only those who were benefited by the improvements. Suppose, in consequence of the deficient water supply, or insufficient system of sewers to a few outlying houses, an epidemic was caused in the district—who suffered; and who were benefited if a better state of things were brought about? He thought that a good water supply was of such infinite importance to the country, that instead of limiting the charge, and putting it on given portions of the community, who were supposed to be specially benefited, but who were only benefited along with others, the policy ought, on the contrary, to be to extend the area of charge, and to apply the principle that, inasmuch as the question of water supply was of importance to the whole community, the whole community within the larger area should bear the cost. The same policy was carried out in other directions, as, for instance, in the case of the School Board rate. Those persons who had no children were not omitted from the operation of the Act. They received no direct benefit from it, but all were taxed alike, because it was supposed that the School Board rate would benefit the whole community; and the same principle was applied in almost all our legislation. It might be quite possible for a local authority to make such a charge as would practically swallow up the whole rates and revenues accruing from

a particular property, and then the owners would not have received all the benefit, nor the occupiers.

Dr. Bartlett wished to make an alteration in section *c*, and to extend it also to the Metropolitan Act. Some four or five years ago, there was the case of the Zoological Gardens, which then, as now, continued to drain wholly into the Regent's-canal. The parochial authorities were appealed to, but they said they were unable to bring the connection within 100 feet of the sewers, and therefore the drainage had continued up to the present moment in the old form. That alteration was therefore required as much in the metropolis as elsewhere.

Mr. Taylor could not agree with Mr. Storey with regard to sub-section *d*. There was no Local Board which would apply this power except in exceptional cases, and this was to protect them. It would be very unfair for a man to build a house 400 or 500 yards away from the main sewer or water-pipe, and then want the water brought to it. It would be impossible for any town to find funds to carry out such a scheme. Very likely that man might have a good well of his own, and might have a scheme of drainage which would do very well, but, at the same time, for the sake of a little greater protection, he would put them to £400 or £500 expense.

Dr. Vacher said if a man had a good well he would not want the water supply.

The Chairman said section *d* applied simply to rural districts.

Mr. Taylor said that was what he was contending. He thought the clause was well framed, and he should like the Conference to pass it.

Mr. Day hoped they would not carry this proposition hastily, because it was quite clear it required great consideration. Since the discussion was started, he had drawn the attention of the original framer of the resolution to an Act of Parliament which he appeared to be ignorant of, and which contained 15 or 16 sections really touching the subject-matter of the resolution. He referred to the Act for the better Local Management of the Metropolis, the 18th and 19th Victoria.

Mr. Cresswell said they were not referring to the metropolis at all.

Mr. Day said no; but this resolution suggested that certain provisions which applied to the metropolis should be made applicable to local authorities under the Public Health Act, and he contended that if they went on the basis of another Act of Parliament to suggest alterations, the Act suggested was not the best one, and that the one he referred to contained much more valuable provisions. If the ressolution as it stood were given effect to, it would, he believed, limit rather than increase the facilities of local authorities for properly discharging their duties.

Mr Chadwick thought the Mayor of Sunderland had not made himself informed of the operation of the Act, which distributed rates over periods of time payable by annual instalments.

Mr. Storey said he was quite acquainted with that Act, because they used it.

Mr Chadwick said that answered all the objections he made against large lump charges. The payment would not be by excessive lump charges on the proprietor, but by reduced charges for contract works, paid by half-yearly or annual instalments by the party benefited, the occupier.

Mr. Weaver asked if the metropolis were exempted from the discussion.

The Chairman said no, it was quite within the power of the Conference to include the metropolis; but, as a matter of fact, the provisions now under discussion were all in the Public Health Act, and they had not before them any resolution or suggestion with regard to it.

Mr. Alcock said it would be open under the last heading. He could speak for a considerable time on this resolution, but he did not wish to take up time by doing so. He should support the resolution originally proposed, for the more it was considered, the more it would be found to be desirable to have an alteration of the law as suggested.

Mr Day moved an amendment, "That in the opinion of this Conference, the Public Health Act, 1875, requires immediate amendment, especially with respect" —and then go on to the various subjects.

The Chairman said that was no amendment. The question before them was, which of these suggestions should be incorporated in that resolution. Section *a* had been struck out, and the proposal now was to retain *b c* and *d*.

This was put to the meeting, and carried unanimously.

Mr. Cresswell said the next head under the amendment of the law, referred to the Pollution of Rivers Act. Every one knew that was a laudable attempt on the part of Parliament to deal with great difficulties, which, from causes which he need not now describe, had become practically inoperative. One of those causes was the unsatisfactory condition of the law, which would be removed if Parliament should affirm the resolution sanctioned yesterday, namely, that County Boards should be charged with the conservation of rivers, and the preservation of these rivers from pollution. One of the difficulties they found was that it was hardly necessary for individuals to set the Act in motion, because there was a much simpler and cheaper remedy in the Court of Chancery, and thus the Act became a superfluity. Two of its provisions were these. It gave a power to somebody, he presumed some aggrieved person, although that was not expressed in the Act, to go before any County-court, and obtain a summary order to restrain the commission of an offence; and the importance of this was that for the first time in the history of legislation the pollution of a river was interpreted to be an offence. It was an offence against the good sense of the community, and was punished like other offences, by a fine of not more than £50 a day; and the jurisdiction to deal with the case and the power to inflict that fine was actually given to County-courts. Under Clause 10 they hoped there would be a speedy and effectual mode of relief, but, practically, Clause 6 nullified that power of the County-court, because no proceedings could be taken by any individual, but application must be made to the sanitary authority, who, in their turn, could apply to the Local Government Board. That was entirely superfluous, because experience taught them that the sanitary authorities were generally the chief delinquents; indeed, many of the most conspicuous sanitary authorities polluted rivers more than any of their neighbours. They were told on the one hand there was power in the County-court, and on the other that that power could only be exercised with the consent of the Parliamentary authority, which was the local sanitary authority, and the Imperial Government in the shape of the Local Government Board. There were other restrictions which probably would be removed sooner or later, but the great difficulty was that, when any individual attempted to set the law in motion, he had to move an inert and stolid body, which refused in almost all cases to be moved. He had then a right to appeal at once to the Imperial authority, which had power to interfere. If the resolution passed yesterday were made the law of the land, all these difficulties would be swept away, because any aggrieved person would apply at once to his own county Parliament, which would have the power to put the Act in force. That was the reason why, under the head of Amendments of the Rivers Pollution Act, the Executive Committee had included that most important question to which he had yesterday

alluded. But they came now to certain details in the Act, not unimportant, but, as compared with the other question, comparatively insignificant. Still they were of importance. First, in Sections 2 and 3 the insertion of the word "knowingly" had given a handle to every counsel who had ever yet been employed on the interpretation of this Act, of at once saying that you must prove a guilty knowledge on the part of the proprietor, or manufacturer, or occupier, and, inasmuch as it was a penal Act, it was construed in the strictest way. It was held that "knowingly" meant a guilty knowledge, and it was almost impossible to prove in any case that any manufacturer, or farmer, or resident, was knowingly polluting a stream. In almost all cases he came forward and said he had given the most stringent orders possible to his servants that they were not to pollute the stream, and although he did not take any pains to see whether it was polluted or not, the Court would always refuse, under such circumstances, to find him guilty. If the clause were amended so that it should read "every person who caused to fall or flow, or permitted to fall or flow," that would simplify the matter immediately. If a man permitted a thing to be done, it implied some action on his part—either action or inaction, which in both cases was reprehensible, and, therefore you had an offence. But, inasmuch as a penal Act was interpreted strictly, he knew from experience (and he was confirmed in that opinion by Mr. Willis-Bund and other learned authorities), that it had practically emasculated the Act. If they really wished to make the Act workable, they would find that expunging the word "knowingly" would considerably assist them. Then, as regards the sub-section *b*, which referred to the words "solid" or "liquid." It seemed a very simple matter, but it was really a very complicated one. The Act defined solid matter as not to include particles of matter in suspension in water; that is to say, matters in suspension in fluid were not solid matter within the Act. Now, inasmuch as nearly all the pollutions going on were by means of matter wholly in suspension in fluids, that at once excluded from the Act very large and very numerous sources of pollution. If you attempted, on the one hand, to deal with the pollution under the solid clause, you were met with the objection that it was not solid because it was suspended matter floating in a liquid. Then, if you turn to the other part, and said you would deal with it as a liquid, you were met with the answer, "It is not in solution; it is matter in suspension," and, therefore, neither provision would apply. No doubt, there were other clauses in the Act which were useful, because it went on to say that you should put no solid matter into rivers, and one of the great causes of obstruction to navigation and injury was from the deposit of undoubtedly solid matter. So far, the Act was applicable, although he was not aware of any case in which it had been applied. But then, again, came the question about refuse and rubbish. The law courts had defined rubbish as that which had no value, and inasmuch as the whole scientific knowledge of the age tended to show that there was nothing which had no value, or that, if it had no value now, you could not say that it had no prospective value. When you talked of rubbish, you had to prove that it had no possible value, and there, again, you were landed in a difficulty. Forty years ago, Lord Durham could not sell his shale, and it might then have been called rubbish, but now-a-days you could not call it rubbish because it was worth almost as much as coal. Again, pyrites, in some cases, used to be considered rubbish, and he knew of cases in the north where mountains of what was once considered rubbish were believed to be sources of wealth. So if you went to Devonshire to the china clay works, there was a great deal of waste matter there which floated away, but you could not say it was absolutely useless. In fact, you never could deal with pollution of rivers in Devon, because almost the only way you polluted th m was by turning in matter in suspension, and that was not within the Act. Without wearying the meeting any longer, he proposed to deal with the question in the simplest possible way; to expunge from the Act altogether, the words "solid" and "liquid," and use the word matter, and then it would be simply for the jury or the Court to decide whether the matter polluted the river or not. If it was a liquid, it was matter, and if it were solid, it was matter. But if you commenced to define it, you gave a handle to the lawyers to interpose. The same wording occurred in clause 4, which he should propose to read:—"Any such poisonous, noxious, or polluted matter" instead of "liquid." Again, in Clause 5, "every person who causes to fall or flow, or permits," &c.; "any matter" instead of "any solid matter from any mine," &c. It was a question of the matter from the mine, not whether it was solid or liquid. If that alteration were made, it would deprive delinquents of a mode of escape. In another part, where it said any refuse of any manufactory, you might retain the word solid. It might also remain in section 2, because it was a clause expressly devoted to the pollution of rivers by solid matters; but subsequently having once defined solid negatively without defining what it really was, it was better to omit the words, because it only complicated and embarrassed the operation of the Act.

Professor Way said there could not be any kind of objection to this alteration. In all probability the framers of the Act avoided the word "matter," because it was a peculiar word to which chemists are addicted. Matter was something, either solid or liquid. It was, in fact, a word which carried both ideas. It could not press with any hardship on those people who were likely to pollute rivers, but prevented them from escaping. With regard to the first suggestion, to omit the word "knowingly;" as a layman, he should have supposed there was no kind of necessity for it, but he deferred to legal opinions. Any man who permitted was supposed to know that a thing was happening, and to have the means of preventing it happening, otherwise the responsibility indicated by Parliament could not exist. One would say it was tautology to say "knowingly permit," because in permitting you had an act of sufferance.

Dr. Voelcker, F.R.S., said he was glad Mr. Cresswell had directed attention to the vagueness of the term solid matter and liquid matter. There was a great confusion in the minds of most people as to what was really solid and what was liquid, and the best means of meeting the difficulty which arose from this vagueness was to cut the knot, and follow the advice Mr. Cresswell had given them. People very frequently thought matter was dissolved when it was really held in suspension, and it was this suspended matter which did all the mischief. He did not care much for matter that settled rapidly, that could be intercepted without much trouble; nor did he very much care for the pollution of rivers by matters which were in actual solution. If the matter was once perfectly dissolved in water, in the sense in which a chemist understood the term, as it came in contact with the air, either by rapid flow or by filtration, the really soluble matter would be, in a great measure, oxidised and rendered harmless, but it was the finely divided and suspended matter which did all the mischief in sewage. In much of the refuse of manufactories this matter remained in suspension, and very soon became solid, and in this process of decomposition produced all kinds of abominations; inasmuch as these matters remained in rivers flowing many miles, it might be truly said that the oxidation was never perfect.

Dr. Tripe supported the resolution, because it was not only common sense, but it was also following the older Acts. In the Nuisances Removal Act, they did not find the word "knowingly," but when you came to the

later Act of 1876, the words either "wilfully" or "knowingly" were put in. With regard to the letting of houses or rooms which were infected, it was rather a difficult thing to prove in a police-court; he had the conduct of a large number of summonses for his Board, and he knew that these technicalities were very bothering. To prove that a man had knowingly let an infected room caused great difficulty, and he had sometimes directed an inspector to go and have a talk with the man, and so get at, in some way, that he did knowingly do it, so that they might be able to prove it. These difficulties were contrary to the common sense and spirit of the Act. He, therefore, had great pleasure in supporting that amendment. As to the question of matter, no one, as a chemist, would use any other word than matter to express everything.

It was then put to the meeting, and carried unanimously, that these two sub-sections should be added to the general resolution.

The Chairman then put the whole resolution in the following form:—

"That, in the opinion of this Conference, the Public Health Act of 1875 and the Pollution of Rivers Act of 1876, with other Acts dealing with public health, require revision and amendment in many important particulars, and that the suggested amendments and additional Clauses subjoined, deserve the attentive consideration of Parliament:—

"1. Public Health Act, 1875—

"*a*. By conferring powers, and corresponding duties, upon local authorities with regard to the construction of sewers, and connection of house drains therewith, not less extensive than those conferred upon the Commissioners of Sewers by the 11 and 12 Vic., c. 112, ss. 37, 38, and 46.

"*b*. By amending section 23, and substituting one hundred *yards* for one hundred *feet*, and empowering the sanitary authority to prevent the continuance in old, and the construction in new, houses, of any drain, sewer, or conduit within the building until an outfall for emptying the same has been provided and constructed to the satisfaction of the authority, other than into any lake, pond, river, canal, or watercourse.

"*c*. By enabling local authorities in rural districts to construct new sewers and water-supply works for the special service of outlying dwellings, and necessary for their healthful occupation, and charging the cost of the same upon the owners or occupiers thereof, payment to be made within a period not exceeding twenty-one years, the intent of such provision being that rates for sanitary purposes in rural districts, including water supply, should, as far as practicable, fall on those only who are benefited by the improvements.

"2. Pollution of Rivers Act, 1876.—Amendments desirable in the Rivers Pollution Prevention Act, 1876, 39 and 40 Vic., c. 75.

"*a*. By striking out of sections 2, 3, 4, and 5 the word "knowingly," as superfluous and embarrassing.

"*b*. By striking out of sections 3 and 4 the words "solid" and "liquid" respectively, and by substituting, whenever necessary, the word "matter."

It was carried unanimously.

The conclusion of the discussion on **Friday, June 11th**, will appear in a future number of the *Journal*.

MISCELLANEOUS.

VITAL STATISTICS.

By T. Baker.

Among the sciences that have made great progress in modern times, is the science of statistics, which treats of the general condition and resources of society. As applied to commercial questions, and manufactures especially, the science has attained a high degree of perfection, and is correspondingly valuable. That branch of the science, however, which we call "vital statistics," and which purports to elucidate the conditions pertaining to the health of communities, cannot be said to have made anything like parallel progress with commercial and political statistics, inasmuch as it will be admitted that there exists scarcely any single deduction, professedly based upon vital statistics, which has not been, if it be not still, largely disputed, or seriously brought into question, by numerous persons claiming to be qualified to form a correct opinion. The reason of this uncertainty probably arises from the fact that, because vital statistics relate to the health of the people, the people themselves take very little interest in their investigation; and the matter is left almost solely in the hands of medical men. It seems to be supposed that because it is the business of doctors to cure disease, therefore it falls within their province alone to consider and treat of all matters relative to the preservation of health. Now the practice of medicine has been, from time immemorial, and is still, a practice of empiricism; and the nature of empiricism has nothing in common with that of statistics. Moreover, the kind of education which instructs a medical student to make use of some particular drug in the "Pharmacopœia," to mitigate certain symptoms, because the great physician So-and-so introduced it at such a time, and the profession have adopted it since; nevertheless, the equally eminent pathologist So-and-so maintains that, for the same symptoms, the exhibition of some other substance is even more efficacious, if not greatly preferable; and, therefore, the practitioner should try one, and then the other, according as he finds this or that best suited to the constitution of his patient, or until some still more patent remedy comes into fashion—this kind of education surely is not that which best fits the student for the pursuit of questions depending upon mathematical precision, or the examination of evidence on which he may base any scientific induction. Hence it is, therefore, that manifold rash deductions are put forward; and hence that "doctors differ" is not more true in relation to symptoms and treatment than to statistics. Premising, then, that it is surely far more the business of a citizen of the world to preserve his own health than it can be of the medical practitioner, whose very maintenance depends upon curing, or mitigating, the diseases and pains of the community, let me point out a few of the kind of statements commonly put forward as "vital statistics," which really are not scientific.

Suppose we take two hospitals, A and B, and say that, in the treatment of a particular disease, the superiority of A over B was shown by the fact that in A the proportion of recoveries to cases had been 50 per cent., whereas in B they were only 20 per cent. This would by no means be a scientific statistic. It might impose upon numberless people, but is of no value whatever. To arrive at any fair comparison in such a case, it is necessary that not one alone, but every possible factor, should be supplied. Now, in the above statement, no mention is made of the number of cases treated in each hospital; the statement may be quite true, but if A had four cases only, while B had five hundred cases, the truth of the statement

will not save it from insinuating, by a *suppressiv veri*, one of the grossest species of falsehood. Often in comparisons of this nature, particular circumstances, such as season, local surroundings, class and condition of patients, length of period during which the comparison is made, are also necessary to be considered; but in no case can the numbers upon which the calculation is made be fairly omitted. Often, indeed, where the numbers are large, as in the case of national statistics, where many millions are taken into account, a balance of some minor conditions may perhaps suffice; but the more limited the area, the more important is it to consider every possible varying condition and circumstance. Yet we constantly see statements analogous to the foregoing put before the public, and called "vital statistics." And, whenever we do, we may be sure the object is to prop up some baseless theory, unless indeed it be "a tale told by an idiot." Whatever the object be, whether to found a theory, or support a foregone conclusion, any suppression of facts, in order to suggest an erroneous inference, is one of the worst species of moral turpitude.

It is to be feared that this kind of parboiling, as applied to vital statistics, is far less uncommon than it ought to be. Hence we hear honest men say they have "no faith in statistics, "statistics may be made to prove anything," and so on; whereas nothing can be more certain, more axiomatic, than deductions from statistics fairly given, where all facts are taken into account, and comparisons, when made strictly *cæteris paribus*. There is sometimes a loose method of constructive reasoning indulged in, as, for instance, that "in the last century such a malady largely prevailed, and vast numbers were destroyed; whereas, during such and such a period, two per cent. only of the population have suffered from the cause in question." This again sounds very convincing, but it is absolutely worthless as a statistic. We cannot compare two periods unless we are furnished with the number of the population at each period, the number of attacks, on competent authority, the number of deaths, and ages at death, at least. Even then, improved methods of treatment, local sanitary surroundings and habits, may give rise to very considerable fallacy in any scientific comparison.

In truth, the science of vital statistics can commence only, in any country, with the date of trustworthy official registration of births and deaths, with classification of diseases, and ages at death. In England this date was 1838.

From thence we are able to obtain the population in the kingdom, or in any district; we can get the mortality during every year, from any specified cause, and the ages of those who died.

If we direct our attention towards the prevalence of any zymotic disease for example, we may thus deduce the death-rate per cent., or, better, per million—where comparison is required—of population; and the proportion of deaths at each age to total deaths from the cause under review. We can, moreover, trace the operation of sanitary improvement from time to time during the periods under examination, the effect of millions expended on works of drainage, supply of pure water, improved ventilation from superintendence of buildings by local surveyors, &c. We can further see, when comparing the proportional mortality at the different ages, the effect of official care in the protection of the young by children's employment commissions, which have laboured and reported at several periods, and, above all, of the large supervision over the employment of women and children in factories, and now in almost all branches of industry, by the large factory department of the Home-office. Enlightened physicians too, may trace the effect of more scientific medical treatment, improvements in the pharmacopœia, and in legislative measures taken to prevent the adulteration of food, the sale of poisons, and diseased meat, &c.

In every inquiry of this nature, however, the greatest care should be taken to guard against fallacy; and fallacy may easily arise. We must have all the factors; no number must be omitted; no circumstances left out of the account. If we would show the result of any improved practice in any particular trade, let us have the population, the number employed in the trade, their ages, the rate of mortality among the whole, and at each age as compared with that in similar localities, their surroundings, &c.; and if any difference of condition or treatment is to be observed, let us be careful to know the numbers under each variety; *e.g.*, it is by some imagined that a particular drug will prevent the effect of lead poison in chemical manufacture. Such a statement as the following has been aforetime put forward:—"Out of 15,000 cases of lead poisoning treated, only four died who had had this specific properly administered. See the wonderful protection thus afforded!" But where is the wonder, or proof, in such an assertion? We are not told how many out of the 15,000 had taken the specific; far less how many had it properly administered. From the bare statement, it would be perfectly possible that the four only who died had the benefit of the supposed remedy. To give per-centages, founded solely upon a varying number of doses, would be equally delusive, the number of recipients and other conditions in each case being omitted. Yet persons unaccustomed to the consideration of figures are but too apt to receive such, and similar statements, as axiomatic proof of the value of a remedy; and the introduction of the "properly administered" provides the quack with an excuse for any amount of failure.

To prove the efficacy of a nostrum, we have seen an amount of suffering, in former times, put forth constructively, when no means whatever of testing the assertion were in existence; and a rate of mortality claimed that, had it been true, would have killed off the entire population to the last man, many decades before the comparison commenced!

With reference to the spread of epidemics, also, we have seen the most positive statements that a particular disease which prevailed at A, was kept out of B by isolation or quarantine, without the smallest attempt to show that no one had passed from A to B, without any reference to the direction of the wind, or of the local conditions of the two places; and yet such valueless opinions have, with the multitude under panic, and fear of contagion, had the effect of setting aside scientific deductions, the result of minute investigations, over 35 degrees of latitude, that the disease in question was invariably dependent on local sanitary conditions, and never in a healthy locality communicated by the sick to their attendants.

On the other hand, in claiming large benefits from sanitation, we have to guard against the fallacy of proving too much. About 20 years ago, some highly important statements (had they been true) were put forth by medical authorities, to the effect that a very large diminution of mortality had taken place in the army, in consequence of certain measures of sanitary improvement, then recently adopted. The per-centage of deaths in the forces were given for a long period prior to the improvements, and, side by side, was placed the then present rate of mortality. The difference was immense! Apparently one-half of those men who had died during the former period, had been sacrificed to the want of appliances and conditions which had since been provided. Unfortunately, this mighty superstructure was destroyed by one most monstrous, and, when pointed out, no less transparent fallacy. During the first period given, recruits were enlisted for an indefinite period, and if any were invalided out of the service such invalids were entitled to a pension. These were therefore treated in hospital by the army surgeon, and if they died, it was the practice to debit the mortality to the army. But before the second period of our famous statistical comparison had arrived, the short

service system had been introduced. The men were then enlisted for 12 years only, and in case of invaliding out, were not entitled to any pension. On this system, a man suffering from any serious malady readily obtained his discharge, by which the regimental doctor would be relieved of trouble and responsibility, and the Department saved the cost of maintenance and burial, or subsequent pension. The sick man returned to the civil population, and if he died, the military rate of mortality at least, was rather diminished than increased by his discharge. What then became of the boasted life-saving by these measures? They may have been to a considerable extent beneficial; but how easily do we see that fallacious inferences may be built up on a base of very slender foundation. A similar claim has been more recently put forth by a correspondent in the *Times*, without the smallest allusion to the different periods of enlistment (first, for life; next, for twelve years; which, in 1870, was reduced to six years), so innocent are authorities on figures when dealing with statistics. The case is quite strong enough when fairly stated, and always suffers by exaggeration. This factor of comparative length of service will be, for a considerable time, no doubt, a very important one in any other statistical calculations relating to the health or mortality from any specific cause in the army, and probably also in the navy. In order to afford results for any practical comparison, not deaths alone should be given, not careful classification of diseases only, but deaths at each year of age, and from each cause separately. Also number of years passed in the service, both in the cases of death from the cause under review, and in invalids discharged by reason of the same specific cause, and the number of years served.

Suppose, again, our inquiry relates to the prevalence of any specific disease, which may be, in its nature, chronic, or of long duration. Among recruits in their first year, a certain proportion suffer from this cause. Under the long-service system, the bad cases would be treated in hospital during the second year, the third, and so on; but, under the short-service rule, such bad cases would be at once discharged, and thus only the number sickening in each year would be the number under treatment from time to time. Obviously, there could be no just comparison as to the prevalence of such disease in the two periods, or as a result of any practice introduced in the second which had not prevailed during the first period. In short, to be of any real practical value, the returns, both in relation to death and disease, should furnish materials for thoroughly exhaustive investigation.

So also in civil life; if, for instance, any real comparison be desired in reference to the prevalence of zymotic diseases, so as to note the march and result of improving civilisation. Fair comparisons can only be made when every possible difference of circumstances is taken into account. We must have age, condition, occupation, local surroundings, and season. The returns should specify the deaths from each specific cause, under one year of age, from one to two, two to five, five to ten, ten to twenty, twenty to forty, forty to sixty, sixty and upwards. The two first years it is very important to distinguish, but usually we jump from one to five. Now, no infant can be said to have attained to what may be called child strength before two years old, and all epidemics carry off most victims in infancy. Often, indeed, the confounding, or mixing up, of infant with adult mortality, opens the door to considerable fallacy in calculating results of sanitary improvement. Children, especially infants, should invariably be kept distinct from adults, and all comparison as to effects of varying circumstances should, as invariably, be made between subjects of the same age.

That sanitation must, in all cases, be productive of benefit, no reasonable and intelligent person can doubt. Take, as an example, the comparative mortality in improved dwellings for the artisan class. It has been customary, however, to compare the death-rate in such model dwellings in London with that of the entire metropolis. But it is manifestly unfair to contrast the value of exceptional improvements in Bethnal-green with the normal mortality of Belgravia: to draw comparisons between suburban districts and the densest purlieus of a crowded city. The comparison should uniformly be made between the average mortality of the population, within the smallest area immediately surrounding the model dwelling which can be obtained, with that of its own mortality. At the request of the directors of the "Metropolitan Association for Improving the Dwellings of the Industrious Classes"—the pioneer society in that movement—I, last year, obtained, at the General Register Office, the mortality in the registration sub-district within which each building of the association is situate; and was thus able to show, as I expected, that the saving of life in these buildings, when contrasted with the average rate of its sub-district, was far greater than it had appeared when compared with the whole of London.

We may, indeed, always feel certain, that improved sanitation will lower the death-rate of any building, district, town, or country. When, therefore, it is asserted that the large expenditure during the last half century, amounting, I believe, in the aggregate to about 120 millions sterling, has had no effect in lowering the death-rate in this country, I stand prepared to deny the statement.

I deny that purer air, by improved ventilation, and the removal of nuisances of every kind, the supply of purer water, the official supervision of women and young children in manufactures of all sorts, and improved medical treatment of diseases of all kinds, have been without effect.

It follows, if I am thus far right, that there must exist some counteracting cause or causes. Let the scientist, then, direct his labours towards the discovery of such counteracting cause or causes.

Given fewer epidemics, resulting from improved sanitation of various kinds, why has not the general death-rate exhibited a corresponding diminution?

One zealot may point to intemperance, but is it true that, in proportion to the population, there is more drunkenness than formerly?

Another enthusiast may urge that increased comforts, or, in other words, more luxurious habits among the community, tend to lessen the constitutional ability to resist the causes which induce death.

A third may point to the more general use of narcotic poisons, as tobacco; but the manufacturer may allege that many hundred-weights of substitutes, such as cabbage leaves, &c., are smoked for one hundred-weight of tobacco.

Every theorist may have his particular fancy, and no doubt the personal habits of the people must greatly affect the weal or woe of their existence, as well as length of days. I much question, however, whether any of the foregoing will anything like suffice to account for this apparent mystery. Could we point to some universal cause, some altered circumstance which affects alike all persons of all habits and conditions, it might help us. Suppose, for the sake of example, the climate of the country had changed for the worse, instead of the contrary (which, I believe, meteorologists will affirm to be the case), that would be a cause altogether independent of the habits of the individual, from which all alike would naturally suffer.

It is manifestly not the purpose of this paper to account for the great and disappointing fact, that thus far, spite of universally-improved sanitation, the general death-rate of England has not been sensibly diminished.

Inquiries of this nature may be carried to any extent, by reference to the Registrar-General's returns. We have at present the general death-rate, and the proportions at fifteen different periods of life, to total. Also a general classification of causes of death. From these

the statistician may find annually, and as far back as his records extend:—

1. The proportion of deaths, from any specified cause, to total deaths.

2. The proportion of deaths at each age, to deaths at all ages.

3. And, further, the proportion of deaths, from any specified cause, at either division of age, to the total deaths at such ages, and to the total of such cause of death respectively.

I have only again to urge, that all deductions, to be of value in the inquiry, must be based on well-ascertained facts, stripped of every possible source of fallacy.

PARIS WATER SUPPLY.

Few cities were worse supplied with water than Paris a few years since—neither quality nor quantity was satisfactory, and the Seine was in danger of being actually drunk up. An addition was obtained by the fine artesian well at Grenelle; but a second well, sunk at Passy, at an enormous expense, proved a total failure for drinking or culinary purposes, and the water may be seen constantly bubbling up—hot, and with a flavour of rotten eggs, in an avenue which leads to the Trocadero. After this failure, the supply of the French capital with water was taken up and carried out under M. Belgrand, who died in 1878, just as the great work of his life was completed. In the first place, search was made for the purest available springs, and those fixed on were the Dhuis, which rises near Château Thierry, and delivers its water in Paris at an altitude of 354 feet; and the Vanne, which rises between Troyes and Sens, at about 112 miles from the capital, and falls into its reservoir at an altitude of 262 feet. The reservoirs which receive the waters of the Dhuis and Vanne, with their tributaries, are situated one on each side of the Seine, the former in the outlying arrondissement of Menilmontant, in the north-east of Paris, the latter at Montrouge, just outside of the city boundaries, on the south or south-west. The quantity of water obtained from these splendid sources is equal to 16 gallons per head per diem, and the water is of fine quality. The water of the Ourcq, brought up to Paris by a canal, is impure, and is used for street watering and sanitary purposes. These reservoirs are of gigantic size, having a lower and upper chamber, and the water flows into them through iron pipes, a mètre in diameter. The reservoirs are covered with a good thickness of vegetable mould and grass, in order to keep the interior cool.

The latter undertaking, the Vanne aqueduct, is interesting, in an engineering and economical point of view; and as no official account has been published, a short sketch of it may be given here. The only official information on this subject was at the Exhibition of 1878, where the municipal authorities showed a series of drawings, models, and accessories of the aqueduct and reservoir.

The Vanne is the name of a valley between Troyes and Sens in Burgumdy. The little streamlet is first caught in earthenware tubes, joined with cement from a number of fissures in the side of a little hill or mound, and these are connected with a secondary aqueduct, which extends from the boundary of the department of the Yonne by Villenueve-l'Archivêque to Theil, where all the streams are brought together, raised to the same level at Malay-le-Roi, and then enter the main aqueduct, which has a diameter of two mètres. Here the aqueduct is formed of chalk, and here it may be stated, that the composition of the aqueduct varies throughout its course with the geological formation of the various regions through which it passes, the material nearest at hand being always employed. Here it is formed in a trench and covered by the earth it has displaced; then it is carried on a series of light arches, a continual fall being maintained throughout. In some places it was necessary to tunnel, and much ingenuity was exhibited in order to ensure accuracy and save expense, but which need not be particularised. The crossing of the deep valley of the Yonne with the river at the bottom, between the Lyons railway and a high road, was a difficulty; the aqueduct entered it at a great height, and had to be carried on in a cast-iron syphon following the profile of the sides of the valley, but carried over road, railway, and river, on three bridges. These bridges were formed of concrete *blocs (bétons agglomérés)*; that over the river being 40 mètres in span. The series of arches in the valley extends 1,800 mètres. At Ville-Saint-Jacques, the conduit had to be tunnelled through solid rock, while in the adjoining valley was found no less than fifteen mètres depth of vegetable mould. The aqueduct passes Moret, and is carried across the forest of Fontainebleau on a series of tall graceful arcades.

JAMIN ELECTRIC LIGHT.

A notice of the new electric lamp, produced by M. Jamin, member of the French Institute and Professor of Physical Science at the Polytechnic School, was printed in the *Journal* for July 25th, 1879, and since that time the inventor has been engaged in improving his lamp. The new apparatus was exhibited lately at the works of the Compagnie Generale d'Eclairage Electrique, Paris, to a large assembly of representative persons.

Around the great hall in which the meeting occurred, were 40 lamps, each containing three candles. The lighting and re-lighting of the lamps was effected instantaneously. This result is obtained, without touching the apparatus, by simply establishing or re-establishing the communication. Should one of the lamps become accidentally extinguished, the other lamps continue to burn as usual, the intensity of their light being unaffected by it. Moreover, should one of the candles be consumed, another is instantly and automatically brought into play. The intensity of the light is completely under control, and may be graduated or regulated at will, from its full power down to the light of a night-light. The inventor states that the lamp may be made to burn 30 hours without any attention.

Mons. Jamin has stated the question of cost in this form:—"Suppose a given quantity of gas to yield a certain amount of light, and that quantity to be consumed in one eight-horse power gas-engine, which drives one of the small Gramme machines, sufficient for sixteen Jamin lamps, the light obtained is ten times that which would have been produced by the direct combustion of the gas itself."

It is further stated, that a series of experiments have proved that each horse-power will give light equal at least to as much, if not more, than that of fifty Carcel lamps. At the concluding meeting, the whole force of a twenty-horse power engine was brought into play, and the effect declared equal to at least two thousand Carcels.

COTTON GOODS OF CHINA.

Mr. Henderson, the United States Consul at Amoy, has lately reported upon the native home-made clothes of China. He says that the great mass of the people, the labouring class of the interior, wear nothing but native homespun, and prefer it to English cloth, even though it cost almost double what anything foreign they have seen ever does. If the looms of America or England can successfully imitate this cloth, or make as good an article with all its essential points, so that it

could be sold in China at a lower figure, there is no reason why a trade should not be built up at the ports of Central China equal in extent to the present total importation of cotton piece goods. The homespun is manufactured wholly of native raw cotton, much of which is carried to Amoy and neighbouring non-treaty ports in junks, so that no record is kept of the quantity imported. Although the threads are rough and uneven, they are composed of pure cotton, and possess great strength and durability—essential qualities in clothing for people who are constantly carrying some object or other on their shoulders. This kind is usually made by the women of the family for the use of their male relatives and themselves, and is now rarely found for sale in the larger market towns on the sea coast. It is woven in widths, varying from 15 in. to 25 in. There is, however, a considerable quantity of cloth being now made in the cities, towns, and villages skirting the inner arms and shores of Amoy harbour, which is composed of English or Indian yarn mixed with Shanghai cotton, the former being used for warp. There is in the minds of the people a peculiar virtue in Shanghai cotton. They claim that an equal weight of foreign cotton, spun and woven in the same manner, will not give as much warmth as Shanghai cotton. The latter is, therefore, mixed with the Indian or English yarn, which can be had much cheaper than the former can be made, in order to secure the desired warmth. This mixture has latterly, owing to its comparative cheapness, pretty well driven the homespun from the market, having left nothing but the very coarsest kinds. It seems to be mostly woven in pieces 21 in. wide by 28 ft. long, containing just enough material for an ordinary Chinese jacket and trousers. Except a limited number of people about the open ports, who have come to know and prefer the foreign article, on account of its cheapness and better appearance, either native homespun or mixed cloth is worn by all classes, at all times, and for all purposes. For winter underclothing, one of these kinds is used by rich and poor alike throughout Central and Southern China, where no fires are kept, save the small baskets of charcoal carried about in the hands.

NOTES ON BOOKS.

The Draining of Lake Fucino, accomplished by his Excellency Prince Torlonia. An abridged account, historical and technical, by Alexander Brisse and Leon de Rotrou. English translation by V. de Tivoli, jun. Rome, 1876. Quarto and folio atlas of plates.

Lake Fucino, situated about 53 miles to the east of Rome, was the largest lake in central and southern Italy, and according to measurements taken on the 10th June, 1861, the surface of its water stood at 2,094 feet above the sea level. The lake was a constant source of alarm and danger to the inhabitants of the surrounding country on account of the frequent inundations. The idea of draining the lake has been entertained since the time of the ancient Romans, but the work was not begun until 1854, when it was undertaken by Prince Torlonia. This work contains a full account of the proceedings connected with the draining of the lake and the reclamation of the land, and is illustrated by a series of 20 plates.

Luxurious Bathing. A sketch by Andrew W. Tuer; second edition, with eight etchings by Tristram Ellis. London, Field and Tuer, 1880.

This is a second and smaller edition of a book already noticed in the *Journal* (vol. 27, p. 928), which is printed in the same old-fashioned type, but is illustrated with a fresh series of etchings, in place of those by Sutton Sharpe in the larger edition.

GENERAL NOTES.

Brush Electric Light at Portsmouth.—The "Inflexible" dock at Portsmouth dockyard was lighted up on the night of the 7th inst. by means of the electric light. The dock is 416 feet long by 110 feet wide, and about 39 feet deep, and the object of the trial was to ascertain whether it were possible, in time of urgent need, to dock an ironclad after dark, or to continue the work of completing her for sea throughout the night. The apparatus used was one of Brush's dynamo-machines, consisting of eight magnets and four powerful electro-magnets, and driven at a speed of 800 revolutions per minute. The lamps were also constructed on the Brush principle. Sixteen of these were placed in the same circuit in various parts of the dock, while a seventeenth was placed in the electro-plating shop near at hand, where the generating machine was fitted. The experiment is reported to have been quite successful.

French Patent Law.—Mr. A. B. Newton, the well known patent agent, has addressed a letter to Lord Granville, asking him, in any negociations for renewing the treaty of commerce with France, to consider a point in connection with the French Patent-law, to which he calls attention. By the French law, the importation of articles patented in France is virtually prohibited, the penalty of importation by the patentee being the voidance of his patent, consequently a patentee whose manufactory is in England, and who has both a French and an English patent, cannot manufacture in this country and import into France without losing his French patent. It is easy to see that such a provision may act very hardly in the case of articles requiring a large and costly plant for their manufacture. Mr. Newton instances the case of a sewing machine manufacturer, who makes his machines on the interchangeable principle. These machines, which are intended for boot sewing, are, it is stated, being largely introduced into the English trade, and there is a demand for them from France which the manufacturer cannot meet without establishing a large and costly manufactory in France. Mr. Newton urges that the law acts prejudicially to both English and French manufacturers. Sir Charles Dilke, in acknowledging the letter on behalf of Lord Granville, promises to bear the matter in mind in any commercial negociations between this country and France.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Sceretary.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 28th...Society for the Protection of Ancient Buildings (at the House of the Society of Arts), 3½ p.m. Third Annual Meeting.

Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr. T. Nordenfeldt, "Nordenfeldt Guns generally."

Wednesday, June 30th...**SOCIETY OF ARTS,** John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.

Statistical, King's College Entrance, Strand, W.C., 4 p.m. Annual Meeting.

Thursday, July 1st...National Indian Association (at the House of the Society of Arts), 8 p.m. Mr. Syed Hassan. "The Social Position and Education of Mahommedan Women in India."

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

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FRIDAY, JULY 2, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council, and the Treasurers' Statement of Receipts, Payment, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday last, the 30th June, at four .m., Lord ALFRED S. CHURCHILL, Chairman of the Council, in the chair.

The Secretary read the notice convening the meeting, and the minutes of the previous annual general meeting.

The following candidates were then balloted for, and duly elected members of the Society :—

Booth, Rev. Samuel Harris, 10, Wynall-road, Forest-hill, S.E.
Bovill, John Henry, Sondes-place, Dorking.
Brooke, George Russell, Springfields, Upper Clapton, E.
Broome, Joseph, Wood-lawn, Didsbury, Manchester.
Brown, Robert Allan, 8, Furnival's-inn, E.C., and Orpington, Kent.
Brownrigg, General J. S., C.B., Ashford-lodge, Staines, Middlesex.
Bruce, William Adair, Ashley, Box, Wilts.
Bullen, John N., Hill-house, Streatham-common, S.W.
Carr, Henry, 21, Cedars-road, Clapham, S.W.
Cawley, George, 468, New-cross-road, Deptford, S.E.
Crew, Charles, Berrywood, Millbrook, Southampton.
Dalziel, W. F. Blyth, M.D., 40, Kensington-park-gardens, W.
De la Sala, Pastor Pérez, Sevilla-house, Navarino-road, Hackney, E.
De Marney, Comte Toreau, Park-cottage, South Kensington, S.W.
Drake, Sir William Henry, K.C.B., 15, Clanricarde-gardens, W.
Drummond, Hon. Francis C., 58, St. George's-square, S.W.
Eberle, Philip, Eberle-street, Dale-street, Liverpool.
Edgar, John, The Terrace, Richmond, Surrey.
Feild, Captain Thomas,
Foster, Bernard Le Neve, East-hill, Wandsworth, S.W.
Foster, Reginald Le Neve, North-end, Droylsden, Manchester.
Glynes, Webster, 6, Staple-inn, Holborn, E.C.
Guyatt, Thomas, 40, King Henry's-road, N.W.
Harrison, James, Dornden, Tunbridge-wells, and Devonshire Club, S.W.
Hart, H. W., Palace-chambers, St. Stephen's, Westminster, S.W.
Hawkins, Alexander, 126, London-road, S.E.
Heath, Vernon, 43, Piccadilly, W.
Hildyard, Captain Robert C. T., R.E., 25, Woolwich-common, S.E.
Hindley, Sidney, 134, Oxford-street, W., and Lightcliffe-house, Hornsey, N.
Hyatt, Robert, Mount Ephraim-road, Streatham, S.W.
Innes, Cosmo, 11, Upper Phillimore-gardens, W.
Jacob, W. H., 59, Portsdown-road, Maida-hill, W.
Jäger, Dr. J. G., Rokén, Amsterdam.
Jenkinson, Henry Irwin, Keswick, Cumberland.
Jeppe, Frederick, F.R.G.S., Pretoria, Transvaal, South Africa.
Kendal, Robinson, Queen Anne's-mansions, Westminster, S.W.
Leighton, Sir Frederick, Pres. R.A., 2, Holland-park-road, W.
Maignen, Prosper Auguste, 22, Great Tower-st., E.C.
Malleson, Colonel George Bruce, C.S.I., 27, West Cromwell-road, S.W.
Marks, John Alfred, 29, Fenwick-road, East Dulwich, S.E.
Marsh, John Charles Lory, M.D., Greenhithe, Kent.
Matterson, William, Endsleigh, Streatham, S.W.
McNaught, John, Rochdale.
Miller, Herbert Percy, 15, Craven-ter., Hyde-park, W.
Mills, Francis Augustus, Waterford.
Mosely, Henry Philip, 32, Torrington-square, W.C.
Nicol, F. A. M., 10, Leamington-road-villas, W.
Paul, William, Waltham-house, Waltham-cross.
Pennington, Nathan Glossop, Park-house, Gloucester-gate, Regent's-park, N.W.
Peters, George, Southville Lawn, Brunswick-square, Gloucester.
Rees, George, Savoy-street, Strand, W.C.
Rhodes, Benjamin, 240, Bow-road, E.
Scott, Ernest, Sir William Armstrong and Co., Newcastle-on-Tyne.
Sellon, Ernest W., 24, Abingdon-villas, Kensington, W.
Severn, Henry Augustus, F.R.G.S., 192, Earl's Court-road, S.W., and Devalah, India.
Sharp, James, 84, Cornwall-gardens, S.W.
Showers, Major-General, Travellers' Club, Pall-mall, S.W.
Sillar, William Cameron, St. James's-lodge, Kidbrooke-park-road, Blackheath, S.E.
Smith, Frederick, Caledonia Works, Halifax.
Smith, Thomas W., Caslon Foundry, 22, Chiswell-street, E.C.
Thornycroft, John I., Chiswick, W.
Vinson, William E., 2, Promenade-villas, Gloucester.
Watson, William, Elmwood, Harrogate.
Westwood, Joseph, jun., The Lake, Snaresbrook, Essex.
Wigham, John Richardson, Albany-house, Monkstown, Co. Dublin.
Williams, John R., 59, Albion-rd., Stoke Newington, N.

The Chairman nominated Dr. Mann and Mr. W. S. Rumsey scrutineers, and declared the ballot open.

The Secretary then read the following

REPORT OF THE COUNCIL.

In bringing before the members their Report on the 126th Session of the Society of Arts, the Council have once more to congratulate the Society on its prosperous and flourishing condition. The period of commercial depression through which we have just passed could hardly have failed to affect its numbers, but it has done so very slightly. It has prevented increase, and in this respect the Society stands practically where it did last year. With a renewal of commercial prosperity, the Council hope will also come a considerably increased growth of the Society's numbers.

I.—ORDINARY MEETINGS.

The Council feel that the list of papers brought before the Society at the ordinary meetings of the past Session will compare favourably with that of any previous Session, and they have every reason to be satisfied with the success of this most important part of the Society's labours. The members have already testified their appreciation of the papers, by their attendances at the meetings to which they have been read, attendances in the aggregate considerably larger than those of any recent Session. The discussions raised upon these papers have also been of a very high character, for they have been taken part in by many authorities eminent in science and in art, members of the Society and others, whose opinions, as recorded in the pages of the *Journal*, have added greatly to the value of the communications on which those opinions were expressed.

The Session commenced with an excellent paper from Major-General Scott, "Suggestions for dealing with the Sewage of London." General Scott has, on several occasions previously, read papers before the Society, and has rendered considerable help in the discussion of those sanitary topics to which the Society has of late devoted so much attention. His last paper, like those which preceded it, was in every respect a practical and useful communication. The second paper of the Session was of a specially interesting character. Under the title of "Apprenticeship, Scientific and Unscientific," Prof. Silvanus Thompson gave his experience of some of the Continental schools for Technical Education, and his views as to the direction which such education could most usefully take in this country. The subject of Technical Education is one of the most important the Society has ever dealt with, and though it has handed over to the new City and Guilds Institute the task of carrying on the Technological Examinations founded by itself, the subject is one in which the Society of Arts must ever feel interest, and in which it will still continue to take some part. Dr. Thompson's paper had the great advantage of being read at a meeting presided over by Professor Huxley, who took the opportunity of giving expression to his views as to the recent action of the Guilds of London in the matter of Technical Education. The criticism which Professor Huxley expressed was followed up by a good deal of correspondence in the public journals, and attracted much attention at the time. On the succeeding Wednesday, Mr. William Simpson, the well-known artist of the *Illustrated London News*, gave the Society the results of some recent explorations of his in the Jellalabad Valley, and their consequence in throwing light on the early art history of Afghanistan. The last paper before Christmas was by Captain Bedford Pim, on the Panama Canal. As is well known, Captain Pim has been for many years working at this subject, and his paper gave some valuable information upon it. After Christmas, the first paper was by Mr. Thomas Bolas, whom the Society knows as having delivered two courses of Cantor lectures before them, its subject being "Modern Autographic Printing Processes." The next was by Mr. Henry Carr, on "Domestic Poisons," and this paper gave rise to the formation of a Committee on the subject, the action of which is noticed in another portion of this report. In succeeding meetings, Mr. William Paul, the well-known horticulturist, brought forward some suggestions as to the proper treatment of Epping Forest, as a place of popular recreation; Mr. Seebohm gave a most eloquent and interesting account of his explorations on the rivers Ob and Yenisei in Northern Siberia; and Dr. Granville Cole brought before the notice of the Society and of the public the very interesting substance known as Spence's metal. This material, which is a mixture of metallic sulphides, principally sulphide of iron, appears capable of many useful applications in the arts, and has some remarkable properties, an account of which was given by Dr. Cole. Its use in several directions is extending. Following Dr. Cole's paper came a communication on "The Euphrates Valley Railway," by Mr. W. P. Andrew, the well-known authority on this subject. No one man has laboured so earnestly and so long at this subject as Mr. Andrew, and his observations received from a crowded meeting the attention they so well deserved. After this was a paper on "The Noxious Gases Bill," by Mr. E. K. Muspratt. This Bill was to have been read a second time on the 15th of March, but was withdrawn, in consequence of the dissolution of Parliament. Whenever the Bill is again introduced, the suggestions made by Mr. Muspratt in his paper, and the opinions expressed in the discussion upon the paper, will no doubt receive their due consideration in Parliament.

On the first Wednesday in March, Mr. A. J. Ellis supplemented the paper he read, three years ago, on "Musical Pitch," by a second communication, of which the Council can only say, that they consider it of equal value with the first. In this paper, Mr. Ellis presented the Society with the results of many years' earnest and careful work. Mr. Ellis was followed by Mr. Sparkes, the Master of the Art School at South Kensington, and of the Lambeth Art School. Mr. Sparkes' paper was also a continuation of a previous communication to the Society, and gave a most interesting account of the advances which have taken place up to the present in the manufacture of the Doulton ware, the introduction of which was related by Mr. Sparkes, in his paper read in May, 1874. Next came papers by Mr. W. Herbert Singer, who was awarded a prize last year, for his essay on the same subject, on "The Art of the Silversmith," and a paper on "Buildings for Secondary Educational Purposes," by Mr. E. C. Robins. Mr. Robins' communication gained additional value from the fact that he is one of the most active members of the City Technical Institute, and has been devoting himself specially to the construction of buildings for technical instruction—buildings such as, it is to be hoped, may soon be seen at South Kensington and in Finsbury, under the auspices of the City Institute. The next paper was by Mr. H. B. Wheatley, the Assistant-Secretary of the Society, upon "The History and Art of Bookbinding." This paper, so far as a short communication of its nature could do so, supplied a want which has long been felt in the literature of the subject, for though the French have published many elaborate works upon bookbinding, the

number of similar authorities in England is very small. Following this, came one of the most interesting papers of the Session, that by Mr. Holman Hunt, on Artists' Materials. Mr. Hunt has long been of opinion that the materials used by artists at the present day are very inferior to those used by the old masters. His paper gave the results of the experience of many years' careful study of the subject, and, embodying as it did the opinions of one of the foremost painters of our time, the Council regard it as of very great importance. The paper itself was too long to admit of any discussion taking place; but the subject has been further discussed at a meeting held on the 8th of this month at the Grosvenor Gallery.

The next paper was by Mr. Thomas Fletcher, who is well known for his labours in connection with the improvement of chemical furnaces. The paper, which dealt with the author's inventions in this direction, was fully illustrated by specimens of the different sorts of furnaces invented by Mr. Fletcher, and attracted much interest. Another most elaborate paper was the one by Mr. J. C. Morton, on "The Last Forty Years of Agricultural Experience." Mr. Morton has carefully watched the progress of English agriculture during that period, and the results of his study were placed in the form of a number of tables before the members of the Society. These tables have since appeared in the *Journal*, and form a valuable body of reference upon the subject. In one of the two meetings which remained before the closing of the Session, Mr. Chas. Wood, of Middlesbrough, brought before the Society his improvements in the utilisation of slag. The Council always welcome any communication bearing on the important subject of the utilisation of substances hitherto regarded as waste products, and Mr. Wood is known to have achieved greater success in his attempts in this direction than has been the good fortune of almost any other of the many inventors who have sought after it. The last paper was by Lieut. Temple, upon the "Trade Routes between England, Norway, and Siberia." Lieut. Temple had made a very adventurous voyage along the coasts of Norway, and the chief object of his paper was to show the importance of publishing, amongst the works of the Hydrographical Department, the result of his experience.

II.—Indian Section.

The principal event of this Section was certainly the reading of a paper by M. Vambéry, on "Russia's Influence over the Inhabitants of Central Asia during the last ten years." M. Vambéry's experience in these regions, and his well-known adventures in them, caused his paper to be anticipated with a very great amount of interest, and this was therefore one of the evenings on which the great room of the Society was the fullest. He came over from Buda-Pesth expressly for the purpose of reading the paper before the Society, although he availed himself of his presence in England to lecture elsewhere. M. Vambéry's paper was preceded by two others, the first one which was read before the Section being a paper by Col. Malleson, C.S.I., on "Herat," a subject which was then prominently before the public; the second being by Mr. Haughton, who discussed the question of the "Best Route for a Line of Railway to India." The scheme which Mr. Haughton put forward differed considerably from that of Mr. W. P. Andrew, who, as noted above, treated the subject of railway communication with India in a paper read at one of the ordinary meetings. Mr. Haughton terms his plan the North Persian route, terming Mr. Andrew's the South Persian route. He would go by way of Mosul to Teheran, Mesched, Herat, Candahar, and joining the railway now in progress from Shikarpore, which will join that already working from Hyderabad to Kurachee: Mr. Andrew going down the Euphrates Valley to the head of the Persian Gulf, and taking the voyage down that Gulf instead of the Red Sea. Mr. Haughton, also, starts from Constantinople, Mr. Andrew from Skanderoon. Following M. Vambéry's paper was one by Mr. Robertson on "Agriculture in South India." Mr. Robertson's experience as Superintendent of the Government farms in Madras lent great weight to the remarks which he put forward, and the paper gained additional value from the observations of the chairman, Sir William Robinson, who was for a time Governor of Madras, and was, therefore, perfectly familiar with the subject treated. The last meeting of this Section was to have been devoted to a paper by M. Terrien de la Couperie, on "China and the Chinese; their Early History and Future Prospects." M. Terrien's researches in connection with early Chinese history and language have led him to several remarkable discoveries, which it was hoped he might have been able to bring before the notice of the Indian Section; circumstances, however, prevented M. Terrien's paper being ready, and, at the last moment, Col. Yule very kindly came forward to supply the vacancy due to M. Terrien's ill-health, by delivering a lecture upon Marco Polo. M. Terrien has, however, since been able to complete his paper, and it is intended to publish an English translation of it in the *Journal*. The translation has been prepared, and it is now receiving the advantage of a revision at the hands of Col. Yule and of Prof. Douglas, of the British Museum.

III.—Foreign and Colonial (late African) Section.

At the beginning of the Session, the African Section, which has now been in steady operation for seven years, had its sphere of activity enlarged by being converted into the Foreign and Colonial Section. Of the seven papers which were communicated to this Section, three were devoted to African subjects. The Rev. G. Blencowe, an old resident in the Transvaal, gave some account of the circumstances which are most immediately concerned in the transition of this State from the condition of an independent community into that of a colonial dependency. Captain Foot contributed some practical suggestions, derived from his own actual experiences in the land, for opening out available trade routes into the interior of the continent, and for turning them into safe channels of communication, by organising upon them permanent stations and systematised transport. The Rev. J. Sibree's account of the progress and promise of the island of Madagascar in the arts of civilisation, and of the peculiarities of the dominant Hova race, which is ethnologically akin to the tribes of the Indian Archipelago rather than to the true African branch

of the human family, possessed a peculiar interest of its own. Mr. Foster's paper on colonisation comprised an instructive explanation of the principles which have been chiefly acted upon in the settlement and occupation of New South Wales. Mr. Pfoundes' paper consisted of a sketch of the social life of Japan, and of the art characteristics of the Japanese mind, which was illustrated by a very large collection of Japanese drawings and works of art. Mr. Warnford Lock's communication on the "Industries and Commerce of Iceland" was a valuable picture of the capacities and state of this approximately Arctic island, Mr. Mitchinson's paper was designed to draw attention to the probability that the injurious effects of equinoctial climates upon European travellers must be ascribed much more to injudicious habits of life than to the unavoidable influence of natural conditions. The change made in the sphere of the activity of this Section placed a larger series of acceptable subjects in the hands of the committee than could be dealt with during the meetings of this Session, and some portion of these have been reserved for future publication. Next year it is hoped that even more satisfactory progress may be made in turning to account the improved opportunities which have been opened out by the enlargement of the Section's area of activity.

IV.—Applied Chemistry and Physics Section.

As the members are aware, the range of this Section also has been somewhat enlarged this Session. Founded in 1874, for the discussion of the various applications of chemistry to arts and manufactures, it has been the means of bringing into public notice many inventions of great interest and commercial value. Though there is still abundant material in the applications of chemistry alone, the Council were of opinion that it would be advantageous to make the Section include also the applications of physical science to the arts. This, indeed, is the more necessary, as the distinction between chemistry and physics is every day becoming less marked. The result of the alteration has been that the Society has had brought under its notice several interesting communications, which it would otherwise have been without.

In the latter part of last Session, the Section suffered the loss of the distinguished young chemist who had taken charge of it since its foundation, Mr. T. Wills. In his place, the Council appointed Mr. J. M. Thomson, the Demonstrator of Chemistry at King's College, and they are pleased to be able to record that the energy Mr. Thomson has shown in carrying on the work, and the time and thought he has devoted to it, have made the appointment a most satisfactory one.

The first paper read in the Section was by Mr. Perry, lately Professor of Engineering in the Technical College of Japan. The subject of Mr. Perry's paper was "The Teaching of Technical Physics." He may be said to have taken a rather opposite view to that enunciated by Dr. Silvanus Thompson in his paper above referred to, and this fact gave an additional interest to it. At the next meeting of the Section, Mr. Herbert Guthrie read a practical paper, on "Gas Furnaces and Kilns or Burning Pottery," a subject to which he has given great attention, and one of considerable importance to this special manufacture. At the third meeting, the beautiful application, by Professor Balmain, of highly phosphorescent bodies to the production of a luminous paint, was brought into public notice in a paper by Professor Heaton. Professor Heaton's paper attracted great attention to it, and the paint is now becoming well-known. It will probably be some time before it can be brought largely into practical use, but every day fresh suggestions are being made of ways in which it might be applied. The next paper was by Mr. Friswell, on "Recent Improvements in Benzene Colours." After this was a very interesting paper by Professor Adams, on "The Optical Properties of Crystals, and some of their Practical Applications," whilst the last paper read was an important communication by Captain Abney, on the "Recent Advances in the Science of Photography."

V.—Cantor Lectures.

As in former years, three courses of Cantor Lectures have been delivered during the present Session. In the course before Christmas, Prof. Chas. Graham, whose lectures on Brewing six years ago attracted much attention, gave the results of his recent work on the scientific principles involved in the manufacture of bread. The second course was by Mr. Thomas Bolas, who was already favourably known to the members by the course of lectures on photography, which he delivered in 1878. The subject of Mr. Bolas's lectures was the important one of the india-rubber industry, a subject which, though it has been dealt with before the Society in several papers and communications, has never before been treated in a course of lectures. Mr. Bolas's lectures were well attended by the members, and by a number of others interested in the manufacture. As with former courses dealing with subjects of Technical Education, a number of tickets were, by the orders of the Council, sent round to the principal manufacturers for distribution amongst their workmen. It is satisfactory to be able to say that numbers of such workmen availed themselves of the opportunity, and appeared gratified at the information which was brought before them. The third course was certainly the most popular of all. It was by Mr. Robert Edis, F.S.A., the subject being "The Decoration and Furniture of Town Houses." This course, perhaps, attracted a larger audience of the members than any which have recently been given in the Society's Rooms. Mr. Edis's principal effort was to show how, without any extravagant cost, houses may be furnished in a fashion which should agree with the most artistic feelings, and yet should not violate any of those canons of comfort which after all should be the chief guidance in such matters.

Dr. Graham's lectures have already appeared in the *Journal* during the Christmas vacation, and the two remaining courses will appear in due order during the summer vacation, which is now about to commence.

VI.—Additional Lectures.

Besides the ordinary courses of lectures, there has been one additional lecture, by Dr. B. W. Richardson, a member of the Society's Council, upon

"Fleuss's Diving Apparatus." Dr. Richardson gave a full account of this remarkable invention, by means of which a diver is enabled to remain under water without any communication whatever with the upper air. The lecture was illustrated by experiments; amongst others, Mr. Fleuss was placed in a chamber filled with carbonic acid gas, and stayed in it some time. The Council are indebted to Dr. Richardson for this very interesting lecture.

VII.—Conference on Public Health.

Amongst the most important of the special subjects of inquiry to which the attention of the Council and of the Society at large has been directed, is the question of the improvement of public health. Since, in 1876, the attempt was made of holding a Conference on this important subject, the Society has called together annually the principal authorities in this country to consider and to discuss various phases of the question. The movement began with a Conference on the Health and Sewage of Towns, in 1876. In that year, a great mass of important statistics as to the methods of sanitation adopted by the principal towns in the country was collected; papers also bearing on the same topics were obtained from many highly qualified persons, and after their discussion, a report was issued by the Executive Committee, which, so far as it related to the ground which it covered, has left nothing to be added up to the present time. This report has been quoted over and over again as laying down the chief rules to be observed as to the disposal of town sewage. It has been quoted and referred to with approbation in at least one Government Report. In 1877, the Conference was held on almost the same lines. In 1878, H.R.H. the President made the suggestion that the Society should endeavour to grapple with the great question of the supply of water to towns in country districts. In this year, therefore, two Conferences were held, one devoted to the question of National Water Supply, and the other to that of the Health and Sewage of Towns. Perhaps the former a little overshadowed the latter; but still the Health Conference was as well attended and as popular as in the first two years. Last year it seemed desirable to consider the whole question together, and a single Conference was held, at which were discussed the question of water supply, and the question of improved sanitation. At this Conference the water supply question principally attracted attention. It was for long a subject for the consideration of the Committee as to what point the discussion at this year's Conference could most wisely be directed, and, after some thought, it was decided that an attempt should be made to sum up and bring together into one focus the resolutions which had been passed, and the suggestions which had been thrown out at all the former meetings, so that whenever, as must soon happen, the whole subject comes up for discussion in the Imperial Parliament, Government might have before it, if it chose to take them into consideration, the matured convictions of those best qualified to offer an opinion In accordance with these views, the Committee drew up a programme for discussion, and in preparing this programme, the Committee feel themselves greatly indebted, first of all, to the Right Hon. James Stansfeld, M.P., a vice-president of the Society, who has occupied the chair at all the Conferences since the beginning, and to whose wise participation in their deliberations the success of these Conferences is mainly due; and in the second instance to Mr. C. N. Cresswell, a member of the Executive Committee, whose legal experience and special knowledge of the laws bearing on the subject of sanitary matters, have been of the very greatest help. The programme was indeed mainly prepared by these two gentlemen, though the Council have also to express their obligations to the other members of the Executive Committee, who gave their best attention to the programme, and to whose suggestions several very important modifications are chiefly due. The result of the two days' deliberations fully justified the anticipations which the Council had in publishing their programme, for while on the whole it was readily accepted by the many eminent sanitary authorities who attended the meeting, it yet received that thorough sifting and discussion which it was the intention of the Council it should undergo. As in former years, the Conference was well attended by representatives from all parts of the kingdom, whose various experience threw much light on many points. The result of the whole was the passing of a series of resolutions, which the Council feel themselves justified in regarding as of very great weight. These resolutions have already appeared at length in the *Journal*; it may be sufficient here to remind the members that they deal with the constitution of County Boards, which the Conference thought should have full and ample power given to them; the revision and amendment in many particulars of the Public Health Act of 1875, and of the Pollution of Rivers Act of 1876; the strengthening of the administrative organisation of the Local Government Board; and the sanitary inspection of dwellings. This resolution came out of a suggestion made by Mr. Cresswell some time back, and embodied in a letter addressed by him to Mr. Stansfeld as the President of the Conference, and published in the *Journal* of the 20th June, 1879.

Mr. Cresswell's notion is that an organisation should be provided, by which the proprietor or occupier of any house could have it inspected by a proper authority, and could obtain a certificate as to its sanitary condition. Very little objection was urged against the proposal, although the original idea was modified in one or two details by suggestions, emanating from members of the Conference. The final resolution embodied a request to the Council that the Conference should again be summoned whenever a suitable opportunity should occur, such as the introduction of a Government measure on the subject of County Boards or local government in some other form, or any other occasion which might afford a suitable opportunity. On this suggestion it is hardly necessary to say the Council will readily act. They do not propose, so far as they can see at present, to summon a meeting of the Conference next year, but they promise the members that the progress of sanitary legislation shall be carefully watched, and they will call the Conference together again, as soon as they think that a useful purpose may be attained by their so doing.

VIII.—Sanitary Section.

As stated in last year's Report, the Council more than a year ago determined upon establishing a Section for the advancement of the Science of Sanitation, with especial reference to structural, rather than medical, considerations, and for this purpose appointed a Committee. This Committee has held a number of meetings during the year now passed, as also during the latter part of the preceding Session, and at these meetings they took the evidence of several distinguished sanitary authorities. Some of this evidence the Committee considered to be of a very valuable character, and they therefore selected that part of it which bore upon house-drainage in London, and brought it before the consideration of a public meeting, on the 14th of the present month. This evidence related to the structural defects of houses, even of the best class, in London, and dealt also with the best methods for ascertaining the existence of such defects and providing remedies for them. The result of the meeting was very satisfactory. A sufficient number of persons interested in the subject, including many representatives of the Vestries and local sanitary authorities of the metropolis attended, and the important evidence above referred to was fully discussed. Pressure of other matter has as yet prevented a report of this meeting appearing in the Society's *Journal*, but it is intended to publish such a report during the recess, as soon as space permits. In connection with this subject, it may be mentioned that, by the kindness of the Right Honourable Earl Spencer, a number of gentlemen were permitted, during the meeting of the Conference on Public Health, to inspect the improved drainage of Spencer-house, St. James's, which was shown to be in perfect working order, transmitting at once all effete matter from the premises in such a way as to remove any chance of nuisance within the house or upon the premises.

IX.—Domestic Poisons.

The paper read upon this subject by Mr. Henry Carr, and referred to above, led to the formation of a Committee to consider the question. Such a Committee was appointed in February last. It held several meetings, and prepared a series of questions which have been circulated amongst manufacturers of dyes, colours, &c., and other traders employing dyes and colours in their manufactures. In answer to this circular a large mass of information has been obtained, which is now under the consideration of the Committee, and the Council hope that the outcome of their deliberations will be a report of considerable value. There seems good reason to believe that this country is considerably behind others in the laws which regulate dealings in these dangerous materials. It must be generally admitted that considerable mischief has occurred from the reckless use of poisonous ingredients in wall-papers, fabrics, &c., though, on the other hand, there has probably been a good deal of exaggeration in the public dread of such matters. Arsenical poisoning is perhaps really less common than it was at one time believed to be, and the employment of arsenical materials seems to be much less extensive than is assumed by many persons. On the other hand, there are certainly authenticated cases of arsenical poisoning, and it is probable that cases of death and of serious illness have occurred through causes which were easily preventable, and might have been avoided had proper regulations been in force. The Council are not yet in a position to say how soon the report of the Committee may be expected, but they believe that when it does appear, it will be accepted as of high value, both by the members of the Society and by the public at large.

X.—Protection of Ships from Loss.

The Gold Medal, for the occasional award of which funds were left under the will of Dr. Fothergill, in 1780, was offered this year for the best means of preserving ships from loss by fire and from loss by sinking. To this was added a Society's Silver Medal, for the best means of protecting ships from fire; and a second Silver Medal for the best means of protecting ships from sinking. The Committee appointed to consider the relative merits of the various competitors for the prize, recommended that the Gold Medal should be awarded to Mr. Donald Currie, M.P., for the improvements he has introduced into his Passenger Steamers, having for their object the prevention of loss of life at sea from fire or accident; and exemplified in the ship *Grantully Castle*, of the Castle Line of Packets, running between England and the Cape. They further recommended that a Silver Medal should be awarded to Mr. J. W. Wood, for his Leak-stopper. The considerations which governed the Committee in their award will be found fully stated in their report, which was printed in the *Journal*. The Council, acting on the above recommendation, have awarded the two medals, and they trust that this recognition of the efforts which have been made by our large ship-owners to provide increased safety to life at sea, may induce others to take action in the same direction, and encourage Mr. Currie himself to continue his public spirited endeavours.

XI.—Owen Jones Prizes.

These prizes are awarded on the results of the annual competition of the Science and Art Department, by the Council of the Society of Arts, as trustees of the sum of £400, the balance of the subscriptions collected by the Owen Jones Memorial Committee, upon trust to expend the interest in prizes to students of Schools of Art who should produce the best designs for furniture, carpets, &c., on the principles laid down by Owen Jones. Each prize consists of a handsomely bound copy of Owen Jones' "Principles of Design," and a Bronze Medal.

The successful competitors were:—T. W. Bradburn, School of Art, Coalbrookdale; Mary Denley, St. Mary's School of Art, Westminster, S.W.; and Joseph Castle, School of Art, Grammar School, Manchester.

In the present year, the Council are able to offer six prizes.

XII.—Albert Medal.

It has already been announced in the *Journal* that the Albert Medal for the present year has been awarded to Dr. Joule, "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the

application of science and industrial pursuits." The Council feel that the award they have made will have received the approbation of the general body of members. It is to Dr. Joule we owe the experimental demonstration of the mechanical equivalent of heat and the law of the conservation of energy. There may be some question whether it was Grove or Mayer who first formulated the theory; whether England or Germany was the country who gave birth to it; but there can be no question whatever that it is to Dr. Joule that we owe the experimental proof of the theory. But the Albert Medal was not instituted to reward scientific merit, however great that merit may be, nor would the Council have felt themselves justified in awarding it for any scientific discovery, unless it could be shown that the discovery had an intimate relation to the arts and manufactures of the country. It is true that all scientific work may, sooner or later, bear fruits in practice, but the view which the Council have always taken is that the practical result must be shown, before the consideration of a discovery comes within their province. Now, the great principle which Dr. Joule has demonstrated to us is one which has its application in every prime mover. It has to be considered in the construction of every steam-engine, and if there is any scientific principle for the application of which we may look for the improvement of our prime movers, it is the principle of the relation between heat and mechanical work. The Council, therefore, feel that the last name which they have added to the list of recipients of the Albert Medal is one which, as they hope may be the case in all future awards, will give additional lustre to that list.

XIII.—MEDALS.

In each year, as the members are aware, it has been the custom for the Council to award a number of medals for the communications brought before the Society during the past Session which they consider most deserving of notice. The number of medals to be awarded has no fixed limit, but depends upon the number of deserving Papers read. It has always been the wish of the Council to keep up a high standard in this respect, and it would be impossible to maintain the same standard year by year if they had at their disposal only a fixed number of medals. In the present year they are fortunate in having had an unusual number of Papers whose merit it seemed desirable to recognise; indeed, the difficulty has been rather to select the best from amongst the large number of excellent papers. Most of the medals have been awarded, as the members will see from the list given below, for Papers read at the ordinary Wednesday evening meetings of the Society; two are given for Papers read in the Chemical Section. Though there were many able Papers read before the Indian Section, the Council did not feel that there were any greatly surpassing the rest in merit; and the same may be said of the Papers brought before the Foreign and Colonial Section.

The following are the awards, in each case of a Silver Medal :—

To Major-General H. Y. D. SCOTT, C.B., F.R.S., for his paper on "Suggestions for Dealing with the Sewage of London."

To A. J. ELLIS, F.R.S., for his paper on "The History of Musical Pitch."

To JOHN SPARKES, for his paper on "Recent Advances in the Production of Lambeth Art Pottery."

To HENRY B. WHEATLEY, F.S.A., for his paper on "The History and Art of Bookbinding."

To W. HOLMAN HUNT, for his paper on "The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters."

To THOMAS FLETCHER, for his paper on "Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes."

To JOHN C. MORTON, for his paper on "The last Forty Years of Agricultural Experience."

To Prof. HEATON, F.C.S., for his paper on "Balmain's Luminous Paint."

To Captain ABNEY, R.E., F.R.S., for his paper on "Recent Advances in the Science of Photography."

XIV.—EXAMINATIONS.

In this department of the Society's work, considerable changes have been made. For some time the Council have had under consideration the desirability of abandoning a portion of the Examinations, and in July last, the Examinations Committee reported to the Council in favour of discontinuing Examinations in all the subjects except Music, Domestic Economy, and Political Economy. The reasons for this determination were fully set out in the report, which appeared in the *Journal* on the 1st of August last, and the same report contains a brief history of the Examinations, to which, those seeking information on the subject, may be referred. The detailed results of the Examinations for the present year are not yet in condition for publication; but they will be ready very shortly, and will then, as usual, appear in the *Journal*.

XV.—MUSICAL EXAMINATIONS.

The Practical Examinations in Music, which was held last year for the first time, have again been held this year, and at the same three centres, London, Birmingham, and Glasgow. The programme of examinations was the same as last year, except that certificates were granted in two classes in Honours, as well as the ordinary First and Second-class Certificates. In London 153 candidates presented themselves, of whom only 6 failed. Amongst the 147 who passed, 178 certificates were granted, some candidates obtaining certificates both for vocal and instrumental music; of these 7 took Honour Certificates (3 first and 3 second), 93 first-class and 78 second. At Glasgow 90 entered, and 88 passed, taking 46 first and 47 second-class certificates. At Birmingham 29 entered, of whom 28 passed, taking 13 first and 16 second-class certificates. At neither of the two last-named centres did any candidates pass in Honours. The examiner reports very favourably of the class of candidates presenting themselves, as may be seen from the small per-centage of failures.

XVI.—MUSICAL EDUCATION.

The Committee, the appointment of which was announced in last year's Report, has since been at work investigating the subject. After holding several meetings, it published a suggested scheme for establishing local music schools, which might be connected with public elementary schools, and eventually with some central college for the highest

instruction in music. The scheme thus propounded has received a considerable amount of approbation from the principals of various training colleges to which it was submitted. The report of the Committee contains extracts from these letters. Since the publication of their report, the Committee have continued their labours, and they hope soon to publish further matter bearing on the question of musical education.

XVII.—National Training School for Music.

The Council are not yet able to report that the final steps have been taken towards the establishment of the school on a permanent footing, but they have every reason to hope that the school will become the basis of the Royal College of Music, about to be esteblished under the presidency of H.R.H. the Prince of Wales, with a charter of incorporation. The negociations referred to in last year's report as pending between the Royal Academy and the Training School, for the purpose of uniting under the common name of the College of Music, have not been brought to the satisfactory issue which it was hoped they might have reached, and it has therefore been found necessary to adopt measures which should render the establishment of the College, with the Training School as its basis, independent. The School Committee, assisted by the energetic endeavours of their chairman, H.R.H. the Duke of Edinburgh, have been working hard for this purpose, and the Council have reason to hope their efforts will soon be successful. They are sure that the Society will continue to support and assist an institution founded, it must be remembered, entirely by its efforts. The members will remember that the fifth and last year, for which most of the scholarships were established, commenced last Easter. Most, therefore, of the scholarships with which the school was first endowed will terminate at Easter next. The funds of the school have, within the last year, been considerably aided by the admission of paying students; there are now sixteen such in the school, and it seems likely that their number will be increased. The scholars selected for the Society of Arts scholarships have proved themselves worthy of the choice, and the reports upon them continue to be of a highly favourable character. It may be added that Lord Newry, who acted as one of the representatives of the Society of Arts on the committee of the school, has retired from it, and the Council have appointed Mr. Henry Doulton, one of their members, to supply his place.

On the 22nd of this month, a concert was given to members of the Society, by the pupils of the school, in the Society's Great Room. In this five of the Society of Arts scholars took part, viz., Eugenie Bénard, Monimia Twist, Elizabeth Turner, Ernest Crook, and Percy Mull; also the following scholars, Eleanor M. Farnol, Mary Arnold, Minnie Webbe, Lucy C. P. Goss, Marianne Jones, Evelyn B. Gibson, Lucy Riley, Annie Ward, Ellen E. Atkins, Grace E. Maile, Bessie Cox, Sophia E. Hudson, John E. Blower, Edward W. Parfitt, Frederick Cliffe, and Bicknell Young. There were also choruses by 35 of the scholars (including the above named). The concert was an excellent one and gave great satisfaction to a numerous audience. In the unavoidable absence of Dr. Sullivan, the Principal of the School, the concert was produced under the direction of Dr. Stainer, the Vice-Principal, Mr. Eaton Faning acting as conductor of the choral class.

XVIII.—Condition of the Blind.

Early in the year, a suggestion was made from some of those who had been instrumental in calling together the Paris Congress for the Improvement of the Condition of the Blind, that an international Congress should be held in England, under the auspices of the Society. The Council appointed a Committee to consider the question, and this Committee decided that while they could not recommend the Council to undertake the organisation of an International Congress, there were yet many reasons why it might be useful to hold a Conference of representatives of the various English institutions dealing with the welfare of the blind. This Committee still has the matter under its consideration, and it is hoped that a Conference on this important subject may be held some time within the next twelve months.

XIX.—Congress on Domestic Economy.

The Council have taken some preliminary steps towards the formation of a General Committee for conducting the next Congress, no date for which has yet been fixed. It is proposed that the Committee shall consist chiefly of ladies. The Council have received the names of five ladies, members of the School Board for London, who will act on the General Committee in their individual capacities. These are Mrs. Fenwick Miller (Hackney), Miss Muller (Lambeth), Mrs. Surr (Finsbury), Miss Taylor (Southwark), and Mrs. Webster (Chelsea). The assistance of ladies, members of Local School Boards throughout the country, will be sought, as well as that of the Principals of the Female Training Colleges, and of others, who have shown an interest in Domestic Economy.

XX.—Drill in Schools.

In last year's Report it was stated that the School Board had charge of the Challenge Banner, presented by the Society of Arts to be competed for at an annual drill review of London Board schools, and then the School Board had under consideration fresh arrangements for the competition. In July last the clerk of the Board addressed a letter to the Secretary, in which he stated the Board proposed to direct their drill instructor to select each year ten of the schools where the boys were most efficient in drill, in order that these schools should meet and compete for the banner. The original arrangement was that all the schools should meet in competition, but it will be remembered that after 1877, it was not possible to continue this system. The Council readily accepted the suggested modifications, and accordingly ten selected schools met on the 11th October, in the grounds of Lambeth Palace, and after a competition, the banner was awarded to the Limehouse School, as showing the greatest efficiency.

XXI.—Artisan Reports.

A full account of the action which led to the preparation of the reports by selected artisans on the Paris Exhibition of 1878, appeared in the

Journal for that and the following year, and was summarised in the last Report of Council. At that time, however, the reports had not been published, though the work of printing was then in progress. It is only necessary to say here that the reports were issued last summer, through the agency of Messrs. Sampson Low and Co., to whom, as well as to the Queen's Printers, the Council are indebted for the trouble they devoted to the matter, and for the liberal terms which they made with the Council for the publication of the book. The reports themselves were well received, and form a valuable contribution to the literature of this, the last great Exhibition.

XXII.—Post-office Telegraphs.

The Council have addressed a memorial to the Postmaster-General, asking him to reduce the tariff for inland telegrams by fixing the limit of charge at sixpence instead of a shilling, as at present. The memorial points out that, as regards cheapness of telegrams, England is behind several continental nations, and refers to the curious anomaly that a telegram can be sent for less money from any part of the United Kingdom to Belgium, than from one part of London to another. Between England and Belgium, the charge for telegraphic messages is twopence a word, and, consequently, a telegram of four words (the sender's name, the receiver's name, the receiver's address, and a word for the message) can be sent for eightpence. Sufficient time has not elapsed since the sending in of the memorial to admit of a reply being received. It is intended to print the memorial in an early number of the *Journal*.

XXIII.—Honorary Life Members.

Acting on the Bye-law which empowers the Council to elect, as honorary life members of the Society, not more than five persons every year, eminent in arts, manufactures, or commerce, or in the applications of abstract science to the same, the Council have, this year, elected Professor Nordenskjöld, the distinguished Arctic explorer, in recognition of the services he has rendered to science, and also, it is to be hoped, to commerce.

XXIV.—Obituary.

Though the losses by death which the Society has suffered during the past year are less numerous than has often been the case, yet many members of note have died since its commencement. As each of these has received due notice in the columns of the *Journal*, it may suffice here merely to record their names. In August last, Sir Rowland Hill died, at the age of 83. In November died M. Michel Chevalier, to whom the Society's Albert Medal was awarded in 1875. In April, the Council lost the services of one of their own body, Lord Hampton. In May, Prof. Ansted died suddenly. These are the principal names which have been removed from our list during the past year.

XXV.—The Journal.

The weekly *Journal* of the Society is now halfway through the twenty-eighth year of its existence; and the Council believe that it still continues to improve, and that it is as valuable a record as it ever was of the progress of Applied Science in this country. The special feature of the *Journal*, upon which the Council have always prided themselves, is the rapid publication of all communications read before the Society at the evening meetings. This adds very much to the value of the communications themselves, and also to the immediate interest of the *Journal*. But besides the record of the Society's own proceedings, the Council have always endeavoured to embody in the *Journal* information of a character bearing upon the Society's work and likely to be interesting to the members. For aid in this they have to thank many correspondents at home and abroad, members of the Society and others; and in doing so they would ask for further help of the same sort. They earnestly hope that members of the Society, especially those resident in foreign countries, will assist them in increasing the value of the *Journal* by sending any communications of a nature suited for its pages. They also trust that they may continue to receive similar assistance from other persons who are not themselves connected with the Society.

XXVI.—The New Council.

During the past year, the Council has lost one of its members by death, Lord Hampton, and, acting under the bye-law which provides for such cases, they filled up this vacancy by electing Sir Henry Cole. The members now retiring by rotation, or by least attendance, are Lord Aberdare, Mr. A. H. Brown, Lord Alfred Churchill, Mr. Hyde Clarke, Mr. Reader Lack, Admiral Ryder, the Duke of Westminster, Professor Erasmus Wilson, and Mr. J. A. Youl. Major-General Cotton also expressed a wish to retire, on the plea that his health did not allow him adequately to fulfil the duties of a member of Council. The Council accepted his resignation with extreme regret, on account both of General Cotton's retirement and of the cause which led to it. Among the retiring members is the name of the Chairman, Lord Alfred Churchill, on the occasion of whose retirement the Council passed the following resolution, which they also determined should be added to this report:—

"The Council wish to testify their appreciation of the services rendered to themselves and to the Society by Lord Alfred Churchill, who has acted as Chairman of the Council for two periods of two years each—from June, 1875, to June, 1877, and again from June, 1878, to the present date. Lord Alfred Churchill leaves the Council at a time when, owing in no small degree to his unceasing exertions in its interests, the Society is in a more prosperous position than it has been in for many years, and the Council wish to take this opportunity of passing him a hearty vote of thanks."

Of the members whose places required to be filled, five were Vice-Presidents and four ordinary members, while Mr. Reader Lack was one of the Society's Treasurers. The Council, in preparing the balloting list for the election of new officers, also removed Mr. Perkin's name from the list of ordinary members in order to propose him as a Vice-President, thus leaving five places in the former, and five in the latter list. To fill these places they now propose:—as Vice-Presidents—Sir Rutherford Alcock, K.C.B.; Sir Frederick Leighton, P.R.A.; William Spottiswoode, LL.D, P.R.S.; Lord Reay; W. H. Perkin, F.R.S.;—as ordinary Members of Council—Admiral Sir F. W. Nicholson, Bart., C.B., Andrew Cassels;

W. H. Preece, the President of the Institute of Telegraph Engineers; Rear-Admiral Mayne; Lieut.-Colonel Webber, R.E.; and as Treasurer—Owen Roberts, the Clerk of the Clothworkers' Company.

The above names will not require any words of introduction. The Council may, however, remark that they esteem themselves fortunate in having secured the adhesion of the presidents of the Royal Academy and the Royal Society, the representatives of English Art and Science.

XXVII.—FINANCE.

The balance-sheet of the Society was published in last week's *Journal*, in accordance with the Bye-laws, so that members have had an opportunity of making themselves acquainted with it before the General Meeting. The Council have no hesitation in expressing an opinion that it is the most satisfactory financial statement they have had the pleasure of submitting to the members for many years. They are glad to be able to fortify their own opinion with that of Mr. Oldfield Chadwick, the Society's auditor, as expressed in the following letter:—

2, Moorgate-street, London,
June 23rd, 1880.

DEAR SIR,—I have to report to you, for the information of the Council, that I have examined the accounts of the Society of Arts in detail, as usual, for the month of May, and have found the same correct.

I have also made a most careful revision and scrutiny of the accounts of the year, for presentation to the members, and publication in the Society's *Journal*, and have certified the same in the usual way as correct.

I have attended with the treasurers at Messrs. Coutts' and the Bank of England, and personally assured myself of the safe custody and due registration at those establishments respectively of the Society's funds and invested stocks.

It is a great satisfaction to me to have to certify accounts so sound and flourishing in their aspect, and exhibited by book-keeping so admirable as is that of the Society.

I am,
Your obedient Servant,
J. O. CHADWICK, Auditor.

H. T. Wood, Esq.
Society of Arts, John-street,
Adelphi, W.C.

Beginning with the debtor side of the account, it will be seen that the annual subscriptions are £120 less than last year; but the life contributions are £221 more, so that the total receipts for subscriptions during the year are £100 more than last year. The total receipts during the year amount to £9,744, and as the total for last year was £10,967 there is apparently a great diminution. This diminution, however, is only apparent, inasmuch as the difference is to be accounted for by the fact that last year the Society had in its possession a considerable amount of money collected for special purposes, and expended during the year. The principal of these sums were £514, subscriptions collected for the Artisans' Reports of the Paris Exhibition of 1878; £155, grant by the Drapers' Company to the Wood-carving School, and £150, grant on account of the Technological Examinations by the Clothworkers' Company. There was also a sale of stock amounting to £318, which was required last year to meet the cost of repairs, and this of necessity appears on the debtor side of the account. The only item of the nature of a trust found in the accounts for the present year is the amount of £100, which Mr. Watherston placed at the disposal of the Society for a prize. Passing to the other side of the account, the first item which may require remark is the expenditure of £166 on repairs and alterations. This, though very much less than last year, when £474 were expended on the new lantern to the Great Room, and on heating apparatus, is still a considerable sum, and is to be accounted for by the discovery that the parapet of the roof of the Society's house was in an absolutely dangerous condition, and required renewal. The members will be surprised to find that the item under the head of salaries and wages shows an increase of £102 upon last year, the amount being £1,791, as against £1,689; and it is important that they should clearly understand that this apparent increase is a matter of account, and not of actual payment. It has been considered desirable that all payments whatsoever made under this head, should appear as such in the balance-sheet, instead of their being charged, as has been the case in former years, under other heads of expenditure. In the balance-sheets of recent years there have been charged to the *Journal*, £260, the editor's salary; to advertisements, £115, for the same; to examinations, £105, the salary of the officer in charge of them. These sums make a total of £480, which might equally well have appeared under the head of salaries. If this sum be added to the amount set down last year for salaries, we get a total which compares with the same item for the present year, and then it will be seen that there has been a reduction under this head of £381. This saving is the result of the re-organisation of the office, which was necessitated by the death, last year, of the late Secretary, Mr. Le Neve Foster. Going back a few years, a still further reduction under this head is to be noted. In the year 1875, the amount paid in salaries, plus the additional charges distributed under other heads of expenditure, but really in the nature of salaries, was £2,425. It will thus be seen that the cost of this head is now more than £600 (actually £624) less than it was five years ago. The Council consider this to be an important fact. It is, of course, consequent upon the alterations which recent years have seen in the staff of the Society. The *Journal* has cost this year £2,442, as against £2,704 last year, the difference being practically accounted for by the editor's salary being charged to the head of salaries, as above stated. The same fact accounts for the cost of the advertisements for the present year being set down as £636, as against £834. The head Union of Institutions is larger than last year by about £60, but on the other hand, there is a set-off of about £50 additional taken in fees for the Practical Examinations in Music. (The fees amount to £110 this year, as against £60 last year.) The Conferences on Public Health and on Water Supply cost £258, this charge last year having been £482. This difference is mainly to be accounted for by the cost of the volume relating to previous inquiries into the supply of water, which was published in 1878, by the Society. There is a charge of £196 under the head of Artisan Reporters, this being the final charge in connection with the

printing and publication of the volume. The sum of £567 received on account of the life contributions has, in accordance with the usual custom, been invested in the Reduced Three per Cents. This, it may be noticed, is the largest investment of life subscriptions which has been made for the last twenty years. The last item in the balance-sheet, showing the amount of the Society's actual balance, appears practically the same as the corresponding item last year. It is really £100 better, because the balance at the end of May, 1879, included rather more than £100 of subscriptions to the fund for the artisan reporters.

And now comes the consideration of the present financial position of the Society, as shown by its assets and liabilities. The total liabilities at the end of the financial year were £1,048, whereas the corresponding amount last year was £2,022. The assets at the same time amounted to £8,783, as against a sum of £8,492 in last year's account, showing an excess of assets over liabilities of £7,735 in 1880, compared with an excess of £6,470 in 1879. The Council would draw the attention of the members especially to the first item of the liabilities, the tradesmen's bills. The amount is only £417, whereas last year it was £1,109; and even last year's amount was considerably below the average. In 1877, the amount was £1,345; in 1876, after the sale of £900 of stock, it was £931; in 1875, it was £1,571. The principal charges under this head are those for printing the Society's *Journal*. For some years the Society has always had a floating debt due to its printer, averaging about £800. During the last five years this has neither increased nor diminished. The Council directed the attention of the Finance Committee especially to this point, in March, 1879, and the Committee, after a careful examination, satisfied themselves that the Society's annual expenditure is met by the annual receipts; in fact, the net excess of receipts over expenditure during the five years ending June, 1878, was £120. By a strict attention to economy during the past year, this debt has been discharged, and the Council propose, in future, to pay ready money to the Society's printer, an arrangement which, of course, enables them to obtain rather more favourable terms. The alteration in the scheme of examinations has lessened the liability on account of the examination prizes; it was £140, but is only £58 for the present year. The general cost of the examinations will also, of course, be largely reduced next year. With regard to the assets, it may be noted that these are calculated at the lowest fair estimate. In calculating the arrears of subscriptions, regard has been had to what the experience of former years shows is actually recoverable. It may, perhaps, be regarded as a healthy sign that this is set down as £50 less than the corresponding amount last year. The whole property of the Society, including pictures, the library, and the lease, &c., is set down at £2,000, which is believed to be a moderate estimate. These are the chief points requiring remarks in the balance-sheet. The Council feel that this improved condition of the Society's finance is in no small degree due to the watchful and unremitting care exercised in this department by their Chairman, Lord Alfred Churchill, to whom their thanks and the thanks of the members are specially due.

The Chairman, at the conclusion of the reading of the report, alluded to several of the subjects referred to in it. He also pointed out that three institutions which had achieved a separate existence during the period he had been on the Council owed their inception to the Society of Arts, viz., the National Training School of Music, the School of Wood-carving, and the Technological Examinations of the City and Guilds of London Institute.

Sir Henry Cole, Vice-President of the Society, then moved the adoption of the report, which was seconded by **Mr. Campin.**

Mr. Hale held that the time of the meeting should not be taken up by the reading of the report, and he further wished to draw attention to several improvements which he had frequently advocated and which he thought necessary for the proper accommodation of the members.

Mr. Campin thought the report should have contained some reference to the necessity of an improved Patent-law, and that the Council ought to have taken some decided action in the matter. It further appeared to him that the presentation of medals to distinguished men, though a very proper action in itself, might be described in the well-known terms which Dr. Johnson used to define a "patron."

Captain Gardner agreed with Mr. Hale that the report should be taken as read, and said that the time of the members would be saved if it were in their hands before the meeting.

The report was then agreed to.

The Chairman declared that the following had been elected to fill the several offices.

The names in *italics* are those of members who have not, during the past year, filled the offices to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Edinburgh, K.G.
H.R.H. Prince Leopold, K.G.
F. A. Abel, C.B., F.R.S.
Sir Rutherford Alcock, K.C.B.
F. J. Bramwell, F.R.S.
Thomas Brassey, M.P.
E. Chadwick, C.B.
Sir Henry Cole, K.C.B.
Sir T. Douglas Forsyth, K.C.S.I., C.B.
Captain Douglas Galton, C.B., F.R.S.
Earl Granville, K.G., F.R.S.
Sir Frederick Leighton, P.R.A.
Sir John Lubbock, Bart., M.P., F.R.S.
Earl of Northbrook, K.C.S.I.
W. H. Perkin, F.R.S.
Robert Rawlinson, C.B.
Lord Reay.
C. W. Siemens, LL.D., F.R.S.
Earl Spencer, K.G.
William Spottiswoode, LL.D., P.R.S.
Right Hon. J. Stansfeld, M.P.
The Duke of Sutherland, K.G., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

G. C. T. Bartley.
George Birdwood, M.D.
R. Brudenell Carter.
Andrew Cassels.
Lieut.-Colonel Donnelly, R.E.
Henry Doulton.
Rear-Admiral Mayne.
Admiral Sir F. W. Nicholson, Bart., C.B.
Sir P. Cunliffe-Owen, K.C.M.G., C.B., C.I.E.
W. H. Preece
B. W. Richardson, M.A., M.D., F.R.S.
Lieut.-Col. Webber, R.E.

TREASURERS.

B. Francis Cobb.
Owen Roberts, M.A.

SECRETARY.

H. Trueman Wood, B.A.

The Chairman moved a vote of thanks to the scrutineers, which was carried unanimously.

Mr. Campin thought that that meeting ought to pass a distinct vote of thanks to the Chairman, in addition to that of the Council, with which the report concluded; he therefore proposed the following resolution, which was seconded by **Prof. Tennant**, and carried unanimously:—

"The members of the Society of Arts, assembled at this Annual General Meeting, beg leave to convey their hearty thanks to Lord Alfred Churchill, for his praiseworthy conduct as Chairman of the Council of the Society, during two separate periods, which office he now retires from at a time of great prosperity to the Society."

The Chairman thanked the meeting for their cordial vote of thanks, with which he was much gratified. He then moved that their thanks be given to the officers.

The Secretary acknowledged the compliment on the part of himself and his colleagues, and the meeting adjourned.

MISCELLANEOUS.

BRITISH ASSOCIATION.

The arrangements for the fiftieth meeting of the British Association to be held at Swansea are as follows:—

The first meeting of the General Committee will be held on Wednesday, August 25, at 1 p.m., for the election of the President and Sectional Officers, and the despatch of business usually brought before that body. The General Committee will meet again on Monday, August 30, at 3 p.m., for the purpose of appointing officers for 1881, and of deciding on the place of meeting in 1882. The concluding meeting of this Committee will be held on Wednesday, September 1, at 1 p.m., when the report of the Committee of Recommendations will be received.

The first general meeting will be held on Wednesday, August 25, at 8 p.m. precisely, when Professor G. J. Allman, M.D., F.R.S., Pres. L.S., will resign the chair, and A. C. Ramsay, LL.D., F.R.S., Director-General of the Geological Survey of the United Kingdom, and of the Museum of Practical Geology, President Elect, will assume the Presidency, and deliver an address. On Thursday evening, August 26, at 8 p.m., there will be a *soirée*; on Friday evening, August 27, at 8.30 p.m., a discourse by Professor W. Boyd Dawkins, F.R.S., on "Primeval Man;" on Monday evening, August 30, at 8.30 p.m., a discourse by Francis Galton, M.A., F.R.S., on "Mental Imagery;" on Tuesday evening, August 31, at 8 p.m., a *soirée*; and on Wednesday, September 1, the concluding general meeting will be held at 2.30 p.m.

On Saturday evening, August 28, Henry Seebohm, Esq., F.Z.S., will deliver a lecture to the operative classes on "The North-East Passage."

The following is a list of the Sectional Officers:—

A.—Mathematical and Physical Science. President—Prof. W. Grylls Adams, M.A., F.R.S. Secretaries—W. E. Ayrton; J. W. L. Glaisher, M.A., F.R.S.; Oliver J. Lodge, D.Sc.; and Donald McAlister, B.A.

B.—Chemical Science. President—John Henry Gilbert, Ph.D., F.R.S. Secretaries—Harold B. Dixon, F.C.S.; Dr. W. R. Eaton-Hodgkinson; P. Phillips-Bedson, D.Sc.; and J. M. Thomson, F.C.S.

C.—Geology. President—H. Clifton Sorby, LL.D., F.R.S. Secretaries—W. Topley, F.G.S., and W. Whitaker, B.A., F.G.S.

D.—Biology. President—A. C. L. G. Günther, M.A., M.D., F.R.S. Secretaries—G. W. Bloxam, M.A.; Professor M'Nab, M.D.; John Priestley; and Howard Saunders, F.Z.S.

E.—Geography. President—Lieut.-General Sir John Henry Lefroy, C.B., K.C.M.G., R.A., F.R.S. Secretaries—H. W. Bates, F.L.S.; C. E. D. Black; and E. C. Rye, F.Z.S.

F.—Economic Science and Statistics. President—George Woodyatt Hastings, M.P. Secretaries—Noel A. Humphreys, F.S.S., and Constantine Molloy.

G.—Mechanical Science. President—James Abernethy, C.E. Secretaries—A. T. Atchison, M.A., and H. Trueman Wood, B.A.

The different Sections will assemble in the rooms appointed for them, for the reading and discussion of reports and other communications, on Thursday, August 26, Friday, August 27, Saturday, August 28, Monday, August 30, and Tuesday, August 31, at 11 a.m., precisely. The reception-room at Swansea will be opened on Monday, August 23, at 1 p.m., and on the following days at 8 a.m.

ON PRESENT IMMIGRATION INTO THE UNITED STATES.

Her Majesty's Secretary of Legation at Washington reports that there is a considerable increase this year in the number of immigrants into the United States, and is of opinion that by the end of the year the country will probably receive a fresh population of more than 400,000, with an additional capital of, it is calculated, 20,000,000 dols. or more. The only serious point as regards Great Britain in this movement are the signs of a possible withdrawal of many of the best skilled labourers, of whom there is a great dearth in America. The greatest immigration into the United States was in 1872 and 1873. During the following years there was a great falling off. In 1872 the number of immigrants was 449,483; in 1873, 437,000, from this number it fell gradually to 138,469 in 1878, but last year it showed again a slight increase, rising to 177,826. This year, however, the number will show probably the largest on record. During the first three months over 35,000 immigrants have landed, against 11,000 for the same period last year, and if this ratio is kept up it will give a total of more than 400,000 at the end of the year. The steamer *Strasburg*, of the Bremen line, landed, some little time ago, at Baltimore, 1,914 emigrants from Germany, Austria, Sweden, and Norway. This is said to be the largest number ever brought across the Atlantic in one vessel; they started the same afternoon for the West in four trains, to settle principally in Minnesota, Iowa, Wisconsin, and Nebraska. The total arrivals at New York for the month of April were 43,261, the heaviest previous month on record being April, 1873, when 42,743 were landed.

It has been generally supposed that the heavy increase of European emigration during the present year has been largely owing to the Irish famine, but this appears to be erroneous. Mr. Jackson, the secretary of the New York Board of Emigration, gives it as his opinion that the Irish emigration has thus far not increased proportionally any more than that of other nationalities, but, on the contrary, the marked increase comes mostly from Germany and the Scandinavian countries; and it is not expected that there will be any considerable influx of Irish until Midsummer, as they seem to have a particular disinclination to cross the Channel until the summer months. A striking feature in the character of the European emigration this year is the large number of Scandinavians who come to establish new homes in the American Republic. This new feature has encouraged the establishment of a direct line from Copenhagen, and one of the steamers of this line has brought over as many as 400 young men, mostly from the agricultural districts of the Scandinavian countries. The heavy decrease of emigration since the panic of 1873 has been particularly conspicuous in the Irish emigration, which in that year was over 83,000, while in 1877 it had sunk down as low as 22,000; last year

it had already recovered to 41,000, or one-third of the entire European emigration. Even according to this ratio the Irish emigration this year should be about 130,000.

Mr. Jackson, in his report to the Board of Emigration, states that in an investigation made by him some years ago, it was ascertained that while the males between the ages of 15 and 40 in the resident population of the United States in 1860 was 21½ per cent. of the whole number, the males between the same ages among emigrants arriving during forty years was 41½ per cent. of the whole number. The total influx during the twenty-nine years has been 7,500,000, and has included the virile portion of a population of 18,000,000—that is, persons of the ages which are nearly coincident with those usually accepted as embracing the period of military service, and are also those of the largest capacity for physical labour. The chief sources of this emigration have been Germany and Ireland, forming about two-thirds of the whole influx in the earlier portion. In the whole period, the German has been about 100,000 the larger. It is a noticeable fact that, of late years, though the whole character of the emigration is better, and the emigrants themselves better clad and more intelligent than those of previous years—that they bring with them less ready money than formerly. An estimate was made some years ago, by the Board of Emigration, of the average amount of cash brought by the emigrants, and it amounted to 68 dols. 8 cents per head; and this was deemed a somewhat low estimate of the real amount. Those who appear to be the best situated as regards the possession of worldly goods are the North Germans and Russians; of the latter, more especially among the Mennonites, it has not been uncommon to find many individuals bringing drafts for 1,000 dols. Twenty of these Mennonite families last year brought the considerable amount of 85,000 dols.

The average amount of cash brought by emigrants during the present year, Mr. Jackson estimates at 60 dols. per head, and taking the total of 400,000 emigrants this year, it will be seen that there is an addition of 25,000,000 dols. to the ready cash of the country. This 25,000,000 dols. of hard cash is, of course, but a very small proportion of the actual and immediate addition of the production and wealth which the present flood-tide of emigration supplies, for it is anticipated that nearly one-half the total, or 200,000 of the emigrants this year, will be male adults, who will sustain themselves by their own labour, and directly add to the production of the country. Custom-house statistics, for the year ending June 30th, 1879, show a total of 177,000 emigrants who arrived during that period, and 111,000 of these, or about two-thirds, were males, while only 65,000 were females. Again, out of the 111,000 males—only a very small proportion—17,000 were under the age of 15, while of the females only 16,000 were under that age, and the number of those too feeble and aged to work was infinitesimal. The railroads are at first the greatest gainers by this influx of emigrants, as about 60 per cent. of the emigrants arriving in New York, leave at once for the Western States, and it is estimated that out of the average, 60 dols. cash each they bring over, about 20 dols. goes for railway fare.

The United States Bureau of Statistics calculates that the amount of capital brought to the country by immigrants for the 50 years prior to 1871 was 6,243,880,800 dols.

AGRICULTURAL COLLEGE FOR NEW ZEALAND.

Attention is drawn in the *Colonies and India*, to the establishment of a "School of Agriculture" at Canterbury, New Zealand, with the object of affording students the opportunity of acquiring a thorough knowledge of the science and practice of agriculture. The institution, which is under the direction of Mr. W. E. Ivey, M.R.A.C., F.C.S., is situated near Lincoln, about 12 miles from the city of Christchurch; and in addition to the school buildings—comprising lecture theatre, library, museum, chemical laboratory, &c.—has attached to it a farm of 500 acres of land of various qualities, from rich swamp pasture land to light and comparatively thin soil, overlying shingle. The farm buildings comprise stables, granary, cow-houses, dairy, piggeries, implement sheds, &c., and are supplied with machinery and farm implements carefully selected with the view of saving labour. The dairy utensils include the improvements introduced in the most recent systems of butter and cheese-making. A portion of the farm is devoted to experimental purposes to test the value of different methods of cultivation, the effect of manures on various crops, the qualities of indigenous and exotic grasses, and the suitability and comparative worth of new varieties of cereals, roots, fodder, and other plants. The students will be required to take part in the regular daily practical work of the farm, to acquire a practical knowledge of ploughing and every other kind of farm work, the use of implements and machinery, the management of stock, and the making of cheese and butter. They will also receive practical instruction in agricultural chemistry in the laboratory. Land surveying and levelling will be undertaken at suitable times for practice in the use of instruments, in measuring land, in harvest and other piece work, and for taking levels for drainage purposes. Lectures and instruction will be given to various subjects connected with agriculture, chemistry, botany, entomology, veterinary medicine, &c. Under the present rules, candidates for admission as resident students are required to pass a preliminary examination; and must be between the ages of 15 and 19.

IMPROVED LIGHTS FOR LIGHTHOUSES.

A summary of the opinions of the lighthouse authorities on Sir William Thomson's proposals for reform in the present system of lights (published in the *Journal* for December 12, 1879) has been printed in the *Architect*. It appears that the Committee of Lloyd's, immediately after the letter was published, wrote to the Board of Trade, stating that they considered Sir William Thomson's idea that each lighthouse should furnish some distinctive mark by which it may be recognised, and not confounded with any other, was well worthy of consideration. The Board of Trade accordingly formally brought the subject under the consideration of the authorities having charge of lighthouses in England, Scotland, and Ireland, and in due time reports were returned to the Board.

Messrs. D. and T. Stevenson, the engineers to the Board of Northern Lighthouses, in their report say that the essential principle of the simple lighthouse characteristics at present in use is that of optical distinction and strongly marked, and, therefore, obvious differences in the periods of light and darkness, while the proposed system consists of intricate and minutely different numericial distinctions in number and order of eclipses crowded into very short periods. The origin of such schemes as that of Professor Babbage and Sir William Thomson is, according to Messrs. Stevenson, an erroneous idea regarding facts which are well established. There is a current and widely diffused, though wholly unfounded, notion that the great cause of shipwrecks is the mistaking of one light for another by the mariner. Mr. Alan Stevenson, in 1851, showed, by statistics of the Scotch coast for four years, that the real cause of shipwrecks at night was not by the mistaking of one light for another, but rather the non-visibility of the lights. Out of 203 shipwrecks occurring in these four years, 133 occurred by night, and in only two of these

was it ever alleged that the appearance of the light had not been recognised, and in only one of these two cases were the lights specified that were alleged to have been mistaken for each other, viz., the revolving light of Inchkeith for the fixed light of the Isle of May. The grand requisite of all sea lights is penetrative power, and not a great variety of characteristics, *i.e.*, by appearances at once appreciable by the eye, or else by broadly marked variations of periods, and not by minute differences exhibited in rapid succession indicative of certain letters of the alphabet, which could only be read by people trained to such a system of telegraphy, or the modification of this system now proposed by Sir William Thomson. Messrs. Stevenson, in conclusion, say that the system of altering all fixed lights to the dot-and-dash, or Morse alphabet, system would, from the minute differences in characteristics, lead not only to perplexity in the mind of the sailor, but, they fear, to disastrous results; and that such a mode of distinction, though it were free from danger, is uncalled for because unnecessary.

The Elder Brethren of the Trinity-house also declined to recommend the adoption of the Morse alphabet as being superior to the methods now in use, or better adapted to the comprehension of every grade of maritime intelligence. It is believed, they say, that if each light of the whole cordon round the coast were taken *seriatim*, there is not one whose identification could not be secured by observations far rougher and less minute than would be required for determining the existence and the sequence of longs and shorts.

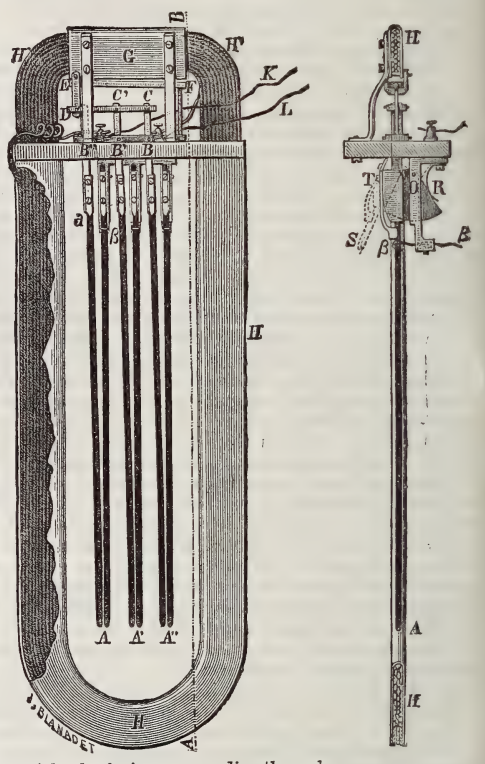
The Commissioners of Irish Lights were found to be less inimical to the new system than any other authorities. It would be injudicious, they believe, to adopt the dot and dash system generally, but the group flashing system could be applied with advantage to those lighthouses on the Irish coasts by which the transatlantic vessels shape their courses. It would be of incalculable use to the masters that, on first making land, either in dark or foggy weather, they should have an unmistakably defined light. The Commissioners point out the concurrence of opinion between their scientific adviser, Dr. Tyndall, and Sir William Thomson. Dr. Tyndall said that it would be easy to give every lighthouse supplied by gas so marked a character that a sailor should recognise it with infallible certainty, and in carrying out his recommendations the Commissioners were very early impressed by the extraordinary facility with which, by the simple turning on and off of gas at any required interval, distinctive variations, to almost any extent, might be made in lighthouse lights, without impairing in the slightest degree the great penetrative power of the light itself. So far back as 1867 they applied this system to Wicklow-head, where, by a very simple piece of clockwork, the light is turned on and off, so as to cause a light of ten seconds, and an interval of darkness of three seconds duration; and in 1871 at Minehead the same principle was adopted with fifty seconds light and ten dark. The use of gas in other lighthouses was recommended; and in 1877, with the approbation of the Board of Trade, the Commissioners placed at the new lighthouse at Galley-head a group flashing gas-light, which was lighted in the following year, and is now, they believe, the most striking example in the world of this kind of light, the flashes of the powerful quadriform revolving light at that station being broken up into groups, producing an effect of unrivalled individuality. This system of group-flashing is capable of almost endless variations.

Sir William Thomson's other suggestions have been received by the experts with more favour. The advantage of coloured lights at important points is no longer insisted on, and Messrs. Stevenson acknowledge that use of colour is attended with disadvantage, not only to men who are colour blind, but to all mariners in foggy weather, when the white lights acquire a reddish hue, so as to stimulate the effect produced by red shades.

JAMIN'S AUTOMATIC ELECTRIC LAMP.

The following description of Mons. Jamin's new lamp (noticed in the last number of the *Journal*) is taken from the *Electrician*.*

The peculiar feature of Jamin's candle, which distinguishes it from all other carbon candles of the same kind, such as those of Wilde and Rapieff, consists in the means whereby the arc between the ends of the two parallel carbon pencils is deflected or drawn out to a flame-like form. The deflection is produced by simply winding the wire conveying the current into an oval loop or hank surrounding the carbons, and the electrodynamic attraction of the current in the wire on the current in the arc.



H, H′, hank of wires surrounding the carbons.
A, A′, A″, the three candles surrounded by the wires.
G, soft iron ring acting as a magnetic pole on the hinged armature E, F.
The sectional diagram shows the carbon holder, hinged socket, shunt action, &c.

In the actual lamp this directing circuit makes 15 or 20 turns round the candles. It is made thin, in order not to obstruct the light, and encased in copper. It is of a rectangular shape, and round the upper end is clasped a soft iron ring, which acts as a magnetic pole, and attracts a hinged armature. In the middle of this frame are placed the candles, or pairs of carbons, between the opposed points of which the arc is to be established. There are usually three of them, but a greater number can be employed if the use of the light is to be prolonged. Each carbon hangs point downwards from a copper socket tube, into which it is set. There is no insulating matter between the carbons, as in the Jablochkoff candle, except air. The right carbon of each pair hangs vertically in a fixed socket, the left

* The block which illustrates this article has been lent by the editor of the *Electrician*.

candle in a movable or hinged socket, and it is arranged that the weight of the armature acts by a leverage on these hinges so as to throw the carbons of each pair together.

The current on traversing the directing coil passes simultaneously down the three movable carbons, and can return by either of the three fixed carbons. In passing it lights those pairs which touch at the points. The passage of the current in this way magnetises the soft iron clasp or ring surrounding the upper end of the coil, and attracts the armature upward, so as to throw the hinged carbons apart from the fixed ones, thereby establishing the full extent of the arc in the first pair of carbons.

The arc continues whilst there is carbon to be consumed. When the current ceases, the armature falls down again, the contact is re-established, and light again kindled. Thus the lamp is automatic.

When the first candle is consumed, the current is diverted to the next succeeding it. To effect this the fixed carbon holder can be displaced in a plane perpendicular to the plane of the coil. This displacement is brought about by a spring pressing on the holder near its root, but whilst the carbon is burning the force of the spring is opposed by a wire catch or detent which holds the carbon in its place. As soon as the latter burns down to this detent and fuses the wire, the spring comes into play, and urges the carbon outwards, thereby breaking up the arc and deflecting the current into the next pair of carbons or candle. The action is so prompt that hardly any change is perceptible, and the other lamps in the same circuit are not affected. Each candle lasts two hours, so that a new one only requires to be substituted at the end of this interval. Moreover, since the brass wire holding the carbon in its place is only fused at the end, it is sufficient to bend a fresh hook on the point, and it will answer the same purpose again and again.

One of the greatest inconveniences of electric lighting is the sudden and possible extinction of one of the lamps. Jamin's candles are not apt to incur this objection; nevertheless, to remedy the inconvenience, a device has been invented by M. Krouchkoll, one of M. Jamin's pupils. This provides for the opening at the moment of accident of a secondary circuit, which continues the current across the faulty candle, and replaces the extinguished lamp with a resistance equal to it, leaving the others in their original condition, and without any access of light.

It will be seen, then, that Jamin's lamp combines several good qualities. It allows of being lit or extinguished as often as may be desired, it only exacts one circuit for all the separate candles, it replaces automatically the burnt candle by a fresh one, it employs no insulating material but air, and therefore does not produce the blue or pinkish colouration noticeable in lights with solid insulators between the carbons. If, to begin with, the light exhibited variations of splendour, they were due to the imperfections in the carbons; but these have now disappeared, thanks to M. Carré, to whom so much is owing for his endeavours in this direction.

The light of each Jamin lamp decreases with their number, a single one with a speed of revolution of 1,500 turns is equivalent to 134 Carcel burners; two lamps in circuit reduce each to 113, and, when there are 14, the individual value is not more than 50 Carcels.

This quantity of light is much more than that obtained by the ordinary electric candles, owing partly to the downward direction of the carbons. When placed upright, the candle illumines the sky and wastes its light, when head downwards the light shines on the ground below. Again, the flame of the arc, when downwards, envelopes the points in an atmosphere at an enormous temperature, which increases their luminosity. A comparative trial of two similar candles in the same circuit has demonstrated that a candle with its points inverted yields five times the light of one with its points uppermost. Although the temperature of the arc is enormous, the quantity of heat is not great, because the amount of matter is small. M. Jamin has compared this heat to that of a Carcel by putting successively the Carcel lamp and an electric candle in the calorimeter. With equal lights, the combustion of the oil developed 45 times more heat than the electric arc.

As to the distance to which the light can be conducted, it is greater in proportion to the speed at which the machine turns. With 1,500 turns, one can introduce in the circuit, the kilomètre of copper wire of the millimètre diameter without sensibly diminishing the intensity. With 2,000 turns, 4 kilomètres of the same wire of 16 kilomètres of two millimètres diameter can be inserted. It is thus possible for a large city to be lighted from the same central works.

It may be stated that Mr. A. J. Berly, C.E., is the engineer and agent for this system, and that it is intended to fix the price of each candle, which, as we have previously said, lasts two hours, at one penny. It is difficult to see how much cheaper carbons can be produced.

FRENCH FORESTS.

The following particulars respecting the present state of Forestry in France are taken from an article in the *Builder*, in continuation of a previous one on Norwegian and Swedish Forests (see *Journal* for February 6th, 1880).

The French forests cover a surface of about 22,688,000 acres, being about 17 per cent. of the total area of France, making her one of the European countries poorest in forest land. Sweden, of European countries, has still the largest per-centage (43 per cent.) of forest-covered soil, notwithstanding the enormous waste that has been going on almost for centuries. Next follow Russia, with 37 per cent.; Bavaria, 32; Austria, 30; the German States (excepting Bavaria and Prussia), 27; Prussia, 23½; Switzerland, 18; France, as above noted, a little over 17 per cent.; Italy, 17; Belgium, 13 to 14; Holland, 7 to 8; Spain, 7; Denmark, 5; and Portugal with 3¼ per cent. Great Britain ranks next to Portugal, having only 4 per cent of her area covered by forests.

The French forests are very unequally distributed over the country. Leaving out the department of the Seine, which has only 2 per cent of forest land, the department of the Manche has the least (3 per cent.), while in that of the Landes the proportion is 47 per cent. or nearly half. The forests cover:—

In 18	departments,	below 10	per cent.	of the soil.
In 42	,,	from 10 to 19	,,	,,
In 17	,,	,, 20 to 29	,,	,,
In 8	,,	,, 30 to 38	,,	,,
In 2	,,	40 per cent. and over		of the surface.

Forests in France are for the most part private property; the Government owning 10·7 per cent., the departments and communes 22·4, public institutions 0·3, and private owners 66·6 per cent. of the forests.

The experience gained by the French Office of Woods and Forests with regard to the acclimatisation of foreign, especially trans-oceanic forest trees, is particularly valuable. The blue gum-tree imported from Australia prospers in the South of France, and by its plantation at the mouth of the Var the marshes surrounding it have been drained, and the fevers formerly prevailing there banished. The trees prosper wonderfully in Algiers, as the section of a trunk not yet fifteen years old, of a diameter of one foot, proves. But the wood is white, light, breaks easily, and cannot be compared with the durable, solid ship-timber which the same tree produces in Australia. The same is the case with the American oak, which prospers in poor soil, grows quickly, and forms beautiful tops of

foliage. But the wood is inferior, the bark contains less tannin than that of European oaks. Trees, consequently, can be planted in certain cases only as surrogates, principally to prepare the ground for better kinds. At present, experiments are also being made with the Californian theya-tree, the wood of which is especially suitable for better classes of furniture; it is doubtful, however, whether its wood will not deteriorate by cultivation in Europe.

The most important feature of the forest display at the last Paris Exhibition, was the illustration of the planting of trees in places which require afforesting. This includes two very distinct categories, the afforesting of heights, and the afforesting of dunes, as well as their turfing, for trees cannot prosper without the growth of grass. On the heights, as well as on the sandy shores of the sea, the labours of the forest cultivator meet with unusual obstacles.

Afforestation proceeds but very slowly in France, and yet that country is acknowledged to possess the best law for afforesting mountains. From 1861-77 but 68,000 acres of mountain-land were planted with trees, and further 3,700 acres turfed. The sum expended in those seventeen years was only £345,000.

The French law of afforestation already referred to, and passed in 1860, orders in its essential provisions that afforestation is to be promoted by public grants of seeds, young trees, money, and other means. Afforesting, if the state of the soil and other conditions make it appear necessary, may be made compulsory. If landed proprietors, communes, and others interested should decline to undertake themselves a regulated system of afforestation, this may be effected by the State, which may take possession for this purpose of the land in question. If persons interested wish, after completed afforestation, to enter again into possession of their soil, and consequently enter upon the enjoyment of the improvements effected by the State, they must repay to the latter the expenses incurred with interest, or cede instead half of the afforested soil. If, notwithstanding this excellent law, proportionately little has been done in France for afforestation, this must be ascribed to the selfishness of the communes and individual persons concerned, which has not been overcome even by the severe trials of inundations.

Amongst the relief plans of afforestation effected that were exhibited at the Trocadéro, that of the Torrent du Bourget is the most remarkable. A plan represents the broad, desolate gorge (near the Barcellonnette in the Basses-Alpes) in its state of 1868,—everywhere only naked rocks and sterile tracts of rubble. The hollow has since been half filled up by the construction of powerful high dams of stone. Trees and bushes, as well as the turf, reach in some places as far as the edge of the gorge, while in its middle the former forest torrent has already visibly assumed the quieter, steadier course of a regulated brook. The valley below has never since been visited by the formerly periodically recurring devastating inundations.

The solidification of dunes by means of the growth of grass and the planting of trees offers difficulties of another kind. The question here is to "fix" the sand-hills and sand heaps, shifted and driven about by the waves like balls. The work must be very gradual. A whole series of dunes is marked out, the line being drawn, as near as possible over their crests. The parting off is effected by means of a strong fencing over the crest of the dunes, towards which smaller cross fences lean herring-bone fashion. The effect of this construction is the accumulation of ever-increasing masses of sand in the places thus protected, which eventually form a bulwark for the space behind against the rush of the waves. The area thus enclosed is first planted with meadow-grass, and next with coniferous trees, the latter being at first protected against sand-drifts by means of brushwood. Sedges, broom, esparto grass also have been employed with advantage for first cultivation. The Exhibition contained relief plans of the dune works and plantations of the dunes between the mouths of the Gironde and the Coubre. The soil reclaimed lies partly below the level of the sea, and amounts already to many thousand acres. Where, a hundred years ago, there was only a desolate and marshy expanse, there the eye now ranges over splendid forests, in which deciduous trees begin more and more to show themselves among firs and pines, while prosperous-looking villages and large herds of cattle, gardens, and vineyards impart life to a landscape which was formerly a silent and dreary waste.

OXIDISED IRON.

Under the above title, the *Times* gives an account of the process employed by Mr. G. Bower, of St. Neots, to produce a coating of magnetic oxide on iron articles. The process may be considered as a modification of that invented by Professor Barff, and described by him in his two papers read before the Society;* but Mr. Bower uses air, or rather, air and gas, whereas Professor Barff employs superheated steam. In his earlier experiments, Mr. Bower caused the articles to be protected red-hot in a chamber heated externally. When they had reached the proper temperature, a few cubic feet of ordinary atmospheric air were blown into the chamber, which was closed, and the iron then entered into combination with the oxygen of the air, a thin film of magnetic oxide being formed on the metal. The operation of blowing in air was repeated as frequently as was necessary to produce the desired thickness of coating, which depended upon the nature of the articles being operated upon. This was the simple air process.

In practice, however, the *Times* says considerable difficulty was experienced in heating the chamber and the articles in it by the external application of heat, and the working of the air system was, moreover, attended by great wear and tear. It then occurred to Mr. A. S. Bower, who was assisting his father in developing the process, that it would be a great step in advance if the iron articles could he heated, and the coating of magnetic oxide at the same time be produced, by the combustion of gaseous fuel inside the chamber. Another series of experiments was, therefore, undertaken, and in the end the desired results were fully attained by means of the apparatus in which the process is now carried out on a commercial scale, and which we recently witnessed in operation at Mr. Bower's works, at St. Neots. This apparatus consists, in the first place, of a set of three small gas furnaces, for the production of carbonic oxide. These are constructed by the side of a chamber sufficiently capacious to contain about a ton of miscellaneous articles, such as umbrella-stands, gas-brackets, saucepans, ornamental iron castings, and the like, which constituted the charge on the occasion of our visit. Beneath the chamber is a series of pipes, in which, before entering the chamber, the air is heated by means of the waste heat from the furnace. The process conducted in this apparatus, and which is a marked improvement upon Mr. Bower's simple air process, consists in alternately oxidising and deoxidising the iron. The articles are heated by burning the gaseous fuel inside the closed chamber. Heated air, in excess of the quantity necessary for the perfect combustion of the gas is made to enter along with the fuel, and this, together with the product of combustion (carbonic acid gas) produces next the metal magnetic oxide, and on the top of it a film of sesqui-oxide, which is reduced to magnetic oxide by shutting-off the supply of air and applying for a short time carbonic acid only. The time required for the treatment of a charge varies from six to ten hours, and on withdrawing the articles they are found to be covered with a protective coating of

* See *Journal*, vol. 25, p. 254; vol. 27, p. 390.

magnetic oxide, which renders them proof against atmospheric influences and the action of moisture.

The process gives a new appearance to the articles, which on leaving the heating chamber assume a beautiful French-grey tint, and this, like the coating, is permanent. As regards the question of economy, it is stated that the absolute net cost of the coating of magnetic oxide is much less than the cost of a coat of paint.

VEGETABLE TRADE OF FLORIDA.

Some particulars relating to the production of oranges and early vegetables in Florida, are given by a correspondent of the *Globe*, who writes from St. Augustine. He stopped at one of the oldest orange plantations in the State, 26 miles from Gainesville, on the road to Palatka, where some of the trees are from 20 to 25 years old; one of them was one foot from the ground, and 4 ft. 8½ in. in circumference. This tree bore, last year, 6,000 oranges; 5,000 of them were boxed and sent to Boston, where they sold for 20 dollars, or £5 per thousand, so this one tree yielded £25 for one crop. Many of the other trees did as well. There are also some Tangerine orange trees, and the fruit from them sold last year for 60 dollars (£12) per 1,000. The oranges are sent north either by train or by steamer, packed in boxes made of pine-wood, planed on both sides. The regulation size of a box is 12 inches long, 12 inches broad, and 27 inches deep. These boxes when full of fruit weigh 90 lbs., and contain from 137 to 170 oranges, according to the size of the fruit. They cost 10 cents. or 5d. per box made up, and 8 cents or 4d. sawn into lengths, but not nailed together. The freight per box from Sanford to New York is 26 cents. per box, or 13d. by water, with one transhipment; by rail, 50 cents., or 2s. 6d.

Gainesville is the centre of the vegetable trade, whence early vegetables are sent to the northern markets, and this new industry pays well. The principal vegetables grown are tomatoes, cucumbers, and melons, all of which fetch high prices. Tomatoes are shipped in crates, which, when full, weigh 50 lbs., and contain about 240 tomatoes, which are packed green, wrapped in paper; these crates cost 10 cents. each, and sell full of tomatoes in New York and Boston at from two dollars and a half to 60 cents. per crate, according to the season; the freight to New York is from 37 to 40 cents. per crate by steamer from Fernandina. Five years ago 4,000 crates of vegetables left Gainesville and its vicinity for the north, and last year over 400,000 crates were sent. This gives some idea of the increase in the trade, which is still growing. The demand for early vegetables in the northern cities appears unlimited. The railroads are constructing and running specially ventilated vans for vegetables and oranges, and the trade is growing apace. The climate and soil of Gainesville and the vicinity are more suitable for vegetable culture than for oranges, and the return is much quicker, though not so permanent. An orange grove bearing is an assured income at little expense, though in 1835 a severe frost killed nearly all the orange-trees in the State, and an insect from Europe finished most of the survivors in 1841. Since then both frost and insect have been less severe in their ravages, and healthy trees suffer very little from either.

CORRESPONDENCE.

INDIAN OPIUM.

Sir George Balfour presents compliments to the Secretary to the Society of Arts, and begs to enclose a statement of the gross and net revenue from opium entered in the finance accounts of India, which will complete the useful memorandum supplied by Mr. P. L. Simmonds, and published in the Society's *Journal* of 11th June, 1880.

The Indian Finance accounts from 1854-55 to 1856-57 show the results of sales of Bengal opium separately from the revenue derived from the sale of passes from Malwa opium exported through Bombay. From 1857-58 the accounts only show the combined results from both sources of revenue.

It would be useful to show the progress of the opium trade immediately before Lin, the Viceroy of the Canton Province, destroyed the opium, and subsequently thereto. The rapid increase in the sale of Bengal and Malwa opium would thus show that the violence resorted to by Lin, in imprisoning the European traders at Canton, to enforce the delivery of opium, some of which had not left India, occasioned a great stir throughout the Chinese Empire, and led to a rapid expansion of the trade.

6, Cleveland-gardens, Hyde-park, 15th June, 1880.

Revenue derived by India from Opium, showing the Gross Collection, Charges, and Net Revenue.

	Gross Cultivation.	Charges.	Net Revenue.	
	£.	£.	£.	
1854—55	1,047,181	14,818	1,032,366	Passes from Malwa opium.
1854—55	3,368,771	1,275,881	2,092,885	Sale of Bengal opium.
1855—56	960,242	13,025	947,217	Passes from Malwa opium.
1855—56	3,910,985	1,143,849	2,767,136	Sale of Bengal opium.
1856—57	1,103,610	16,413	1,087,197	Passes from Malwa opium.
1856—57	3,586,140	1,054,222	2,531,918	Sale of Bengal opium.
1857—58	6,864,209	945,834	5,918,375	Sales and passes combined.
1858—59	6,146,342	799,951	5,346,391	,, ,,
1859—60	5,887,778	718,000	5,169,778	,, ,,
1860—61	6,676,759	918,467	5,358,292	,, ,,
1861—62	6,359,269	1,449,465	4,909,804	,, ,,
1862—63	8,055,476	1,856,278	6,199,198	,, ,,
1863—64	6,831,999	2,306,493	4,525,506	,, ,,
1864—65	7,361,405	2,377,020	4,984,385	,, ,,
1865—66	8,518,264	1,894,282	6,623,982	,, ,,
1866—67	6,803,413	1,077,335	5,726,078	,, ,,
1867—68	8,923,568	1,874,153	7,049,415	,, ,,
1868—69	8,453,365	1,720,150	6,733,215	,, ,,
1869—70	7,953,098	1,820,711	6,132,387	,, ,,
1870—71	8,045,459	2,014,425	6,031,034	,, ,,
1871—72	9,253,859	1,596,672	7,657,187	,, ,,
1872—73	8,684,691	1,814,276	6,870,415	,, ,,
1873—74	8,324,879	2,001,484	6,323,395	,, ,,
1874—75	8,556,629	2,341,847	6,214,782	,, ,,
1875—76	8,471,425	2,219,399	6,252,026	,, ,,
1876—77	9,122,460	2,841,679	6,280,781	,, ,,
1877—78	9,182,722	2,661,385	6,521,337	,, ,,
1878—79	9,399,401	1,700,369	7,699,032	,, ,,
1879—80	10,459,000	2,058,856	8,400,144	,, ,,
1880—81	9,410,000	2,160,000	7,250,000	,, ,,

NOTES ON BOOKS.

La Reliure Française, depuis l'invention de l'Imprimerie jusqu'a la fin du 18e Siecle. Par MM. Marius Michel, Relieurs-doreurs. Paris: Morgand et Fatout; Londres: Bernard Quaritch. 1880.

Messrs. Morgand and Fatout, whose illustrated catalogues are alluded to in the number of the *Journal* for April 16th last, have just published a handsome volume containing a study of French Bookbinding from an

artistic point of view, in which a description of the various styles, adopted at different periods, is illustrated by examples of the works of masters of the art, chosen from celebrated libraries. The series of twenty-two plates commences with a specimen of Royal binding, from the library of Francis I, ornamented with his initial and device of a salamander, and ends with a copy of the side of one of Louis XVI's books. Besides, there are representative specimens from the libraries of Grolier, Henry II, and Diana of Poitiers, Henry III. (with a medallion of the crucifixion on the side), Henry IV. (with the arms of France and Navarre), Louis XIII, and Anne of Austria, Prince Condé, the Regent Philippe d'Orleans, Comte d'Hoym, Superintendant Fouquet, and Sir Kenelm Digby, whose books were mostly bound in France. Besides these plates, there are blocks in the text, of ornamental borders, in use at different periods, and of tools employed by celebrated binders. All the specimens referred to above are known by the names of their former possessors, and not by the names of the binders. Books are often described as bound by De Rome, Padeloup, or other bearers of celebrated names, but in order to indicate the binder definitely, it is necessary to add the christian name, for there were families of binders with the several names of De Rome, Padeloup, Boyet, and Bradel. At least one member of the family of De Rome was in business during a period of more than a century. But there is another difficulty with respect to the earlier binders. Nicholas Eve was binder to Henry III., and Clovis Eve to Henry IV. and Louis XIII., but we have no proof that the Eves (to whom much beautiful work is attributed) really bound these books themselves, and exhibited their own taste in their production. They were Royal printers, binders, and booksellers, and probably employed artists to work for them, whose names are now entirely lost. At the end of this elaborate work of MM. Marius Michel are some notes, which contain biographical particulars of certain of the well-known binders, some of which are taken from the researches of Mons. Jal, published in the "Dictionnaire Critique de Biographie et d'Histoire."

GENERAL NOTES.

Annual Exhibitions.—The directors of the Crystal Palace propose to hold a series of special annual International Exhibitions, in connection with their ordinary arrangements, and have appointed Mr. P. L. Simmonds to arrange and manage the same.

Educational Congress at Brussels.—The final prospectus of the Ligue de l'Enseignement, for their Congress at Brussels, has recently been issued. The Congress will meet from the 22nd to the 29th of August. Papers can be read, or addresses delivered, in any language, and the members of the committee undertake to translate the substance of such paper or addresses into French for the benefit of those attending. The Congress is composed of effective and honorary members. The subscription for effective members is twenty francs, and includes a copy of all the publications of the Congress. Certificated teachers and some others are accepted at a lower scale, their subscription being ten francs; the subscription for honorary members is five francs. Members can obtain railway tickets at reduced prices. It is proposed to open an office, at which information as to lodgings, &c., can be obtained. Delegates have been appointed to attend the Congress by the ministers of Public Instruction of several of the European States, and by the Government of the United States of America. Persons wishing to take part in the proceedings of the Congress should apply to Mr. Buls, the Sheriff of Brussels. Mr. Trueman Wood, the Secretary of the Society of Arts, has undertaken to act as honorary secretary for Great Britain, and he will be happy to send a prospectus to any person desiring one.

City Institute for Technical Education. — It is announced that the City and Guilds of London Institute for the Advancement of Technical Education has definitely accepted a site for the Central Institution in Exhibition-road from her Majesty's Commissioners for the Exhibition of 1851. The site is 300 feet long, and is between the temporary French and Belgian Courts. The advantages of this site are stated to be its proximity to the museums and libraries, and science and art schools of South Kensington. The central institution, when erected, will be used for the training of teachers, and will provide the highest technical instruction to students who have already obtained such a knowledge of the elements of science as is furnished by the School of Mines and other scientific institutions.

The Pneumatic Telegraph in Paris.—Since the reduction of the charge for a single message by the pneumatic system, that is to say, since the first day of last month, the number of messages sent has more than doubled. From some statistics published in Paris, it appears that when a message has only to traverse a single section of the tube, eight minutes are only expended, including the necessary office business appertaining to the message; for each section after the first, five minutes more must be added, and as the great majority of messages, pass through four sections, the average time per message is equal to twenty-five minutes. There are, however, distances of eleven sections, and one, that from the Bastile to the Place du Frone, of twelve sections, and in the last case the journey occupies sixty-three minutes. Measures are now being taken to shorten, if possible, the time occupied by the passage of the cards through the tubes.

Glasgow Gas Exhibition.—The Philosophical Society of Glasgow have resolved to hold an exhibition of apparatus, illustrative of the most recent developments in the use of gas, electricity, &c., for lighting and other purposes, in September and October next. The range of subjects to be illustrated by the exhibition will include apparatus, appliances, models, or drawings that relate to, or illustrate, any of the following, viz.:—1. Coal-gas.—Its manufacture, purification, storage, distribution, regulation of pressure, and measurement. Its utilisation in lighting, heating, cooking, ventilating, and as a motive power. Photometric testing of gas or other sources of light. Residual products of gas manufacture, coke, tar, benzole, aniline dyes, ammonia, salts, &c. 2. Oils, Oil-gases, Candles.—Their manufacture and use for lighting, heating, cooking, and motive power. 3. Electricity.—Its generation and application for lighting, telegraphy, motive power, &c. 4. Hydraulic Appliances.—Motors suitable for comparison with gas-motors, and apparatus for the measurement and regulation of the flow and pressure of water. 5. Architectural Appliances.—More especially those which relate to lighting, ventilation, heating, and lightning conduction; and architectural iron-work and sanitary appliances such as can be exhibited in the open grounds. 6. Miscellaneous Apparatus.—Gas-lighted buoys, fog horns, miners' safety lamps, fire-damp indicators, and apparatus for lighthouse illumination, ventilation of mines, &c.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Sceretary.

MEMBERS' SUBSCRIPTIONS.

The Midsummer subscriptions are now due. Cheques or Post-office orders for the above should be made payable to H. T. Wood, or order, crossed "Coutts and Co."

JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, JULY 9, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CHAIRMANSHIP OF THE COUNCIL.

On Monday last, the 5th inst., at their first meeting, the Council elected Frederick J. Bramwell, M.Inst.C.E., F.R.S., as chairman for the ensuing year. The various committees were also re-appointed.

POSTAL TELEGRAMS.

The following petition has been transmitted by the Council to the Postmaster-General:—

To THE RIGHT HONOURABLE HENRY FAWCETT, M.P., HER MAJESTY'S POSTMASTER-GENERAL.

The Memorial of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce

RESPECTFULLY SHEWETH,—

That the Council are strongly of opinion that the time has now arrived when the charge on inland telegrams might be reduced, and a minimum charge of sixpence substituted for the present one of a shilling.

They submit that the charges on inland telegrams in this country are higher than in other European countries, the rates in France, Germany, Belgium, and Switzerland, all being lower than in England. It is even a curious anomaly that a telegram can be sent from any part of the United Kingdom to Belgium or to France for less than the smallest sum for which a telegram may be sent from one part of London to another.

The Council do not propose to make any suggestions as to the details of the method by which the reduction of charge should be effected; whether by employing a lower tariff within certain limited districts, such as the metropolis and its suburbs, or the country within a certain radius of a provincial town; or, secondly, by adopting a word-tariff, with a minimum charge of 6d. The precise details are, the Council feel, safely to be left to the department itself.

They feel sure, however, that a reduction in the tariff would be accepted as a boon by a large number of those who are prevented, by the present rates, from using the telegraph as largely as they would wish, and that the business of the department would soon be so increased as to fully compensate for the lessened revenue which might be the first consequence of the proposed change.

(Signed)

ALFRED S. CHURCHILL, Chairman of the Council.
H. T. WOOD, Secretary.

NATIONAL INSURANCE.

A Public Meeting will be held by the Society, on Wednesday next, 14th inst., at 3 p.m., at which a Lecture on the subject of "National Insurance" will be delivered by the Rev. W. L. Blackley, M.A., to be followed by a discussion. The Earl of Shaftesbury, K.G., will preside.

Tickets of admission can be obtained on application to the Secretary of the Society of Arts.

"OWEN JONES" PRIZES, 1880.

This competition was instituted in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Science and Art Department.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design" and a Bronze Medal.

The following is a list of the successful candidates:—

1. J. W. Riley, School of Art, Halifax—Designs for carpet and for chintzes.
2. G. Potter, School of Art, Derby—Design for a wall paper.
3. Fanny Buckfield, School of Art, Northampton—Design for muslin.
4. Lucie Shepherd, School of Art, Northampton—Design for a cretonne.
5. James Henderson, School of Art, Dundee—Design for a chimney-piece.
6. Thomas Smith, School of Art, Coalbrookdale—Design for hearth tiles.

ANNUAL CONFERENCE ON PROGRESS OF PUBLIC HEALTH.

Friday, June 11th; the Right Hon. JAMES STANSFELD, M.P., in the chair. The proceedings were continued as follows:—

The Chairman invited Mr. Cresswell to open the discussion on the following resolution, under the head III.—Sanitary Inspection and Classification of Dwellings:—"That it is expedient that the Metropolitan Board of Works within the metropolis, and the County Board within each county, should be empowered by the Legislature to make provision for the inspection and sanitary classification of dwellings, upon application being made by the owners thereof; and to grant certifi-

cates of healthworthiness in different categories, for terms of years, according to the perfection of sanitary equipment and fitness for habitation of such dwellings; and to determine the scale of fees to be paid for such inspection during construction and repair, and also upon delivery to the applicant of the certificate of classification awarded to such dwelling."

Mr. Cresswell said, after the Conference of last year, it occured to him that something more was necessary to induce the British proprietor and occupier to do his duty to himself and his neighbour than the mere fact that he was doing a virtuous act, and the satisfaction which ought to arise from the performance of it; that the only way to bring about—not only in the metropolis, but throughout the country—the effectual operation of sanitary laws, was by making the performance of a social duty identical with the self-interest of the person in question. He put his ideas before the right hon. Chairman in walking from that room at the conclusion of last year's meeting. Mr. Stansfeld listened with respectful consideration to anything which would improve the sanitary condition and promote the well-being of the British people, and said that if he (the speaker) would put his ideas in writing, he would consider it. The result was the letter which appeared at page 661 of last year's *Journal*, to which Mr. Stansfeld's reply was appended. In that letter would be found a succinct exposition of the idea which ooccurred to him. This idea was not wholly new, because the idea of sanitary inspection had occurred to hundreds of thoughtful men before his time; indeed, an intelligent engineer did, to some extent, propound that idea some years ago, but it was confined, so far as he could learn, to sanitary inspection, and a company was projected for the purpose of enabling the British public to obtain that information which they so urgently required, though its *employés* did not go any further, so far as he recollected, than the proposal to inspect and report for the satisfaction of persons seeking their assistance. Again, in the north of England and in Scotland, an association was formed some years ago, somewhat on a co-operative principle, whereby occupiers or tenants of houses would be able to obtain, upon moderate terms, that valuable information, through the working of a private association, which would employ experts and competent men to ascertain the facts with regard to houses, and impose the necessary conditions in order to obtain a satisfactory certificate at as cheap a rate as the public could be expected to afford on a subject which vitally affects their well-being. He believed that it was a success in Edinburgh, but he was bold enough to assert that it had never occurred to anyone yet—although an article in the *Globe* last night informed him that it was so simple a matter that they wondered that it had never occurred to anyone before—to classify houses in the same way as ships were classified at Lloyd's. When a man went into the City to charter a ship for India, if he were not a broker himself, he went to a broker (who, in the case of a house, would be represented by a house-agent). He asked the broker the character of the ship which he saw advertised in the columns of the daily papers. The broker turned at once to a book known as Lloyd's Register, and saw that the good ship *Mary Ann*, chartered for the purpose of conveying goods to Calcutta, for instance, was registered A1 for 16 years. That was sufficient for him; he asked no further questions, but at once engaged freight, and paid the highest price, because he felt confident that his goods would be carried with safety to Calcutta, and that he would be able to insure them at the lowest possible premium at Lloyd's. That classification at Lloyd's was not obtained without the fulfilment of onerous conditions. From the birth of the ship to the crowning of the edifice by the flag of England was a work of time and labour. The keel was laid down under the superintendence of Lloyd's surveyor; the beams, scantling, and every portion of the ship was watched vigilantly during the progress of construction. Before her decks were closed, in a very accurate examination was made, both of the interior and exterior. If she were copper fastened and copper bottomed, the quality of the copper was well tested, and the strength of the fastening accurately gauged, until at last she was masted, and the cordage put upon her, that was tested also, and when that was done to the satisfaction of Lloyd's surveyors, the ship was said to be taut and trim, staunch and true, and was registered A1 for 16 years. That meant you had a valuable property worth £15 to £20 a ton; but without that certificate she would probably not be saleable at all in the market. Why should not the same principle be applied to house-building? If it was necessary to protect the lives of our sailors (of which they had heard so much from the late member for Derby), to secure the property of merchants, and the lives of passengers, surely, *a fortiori*, it must be necessary and expedient to protect the lives of the great mass of the inhabitants, who did not go down to the sea in ships, but were satisfied to remain on *terra firma*. If, on the other hand, you say it is a novelty, and that the public would not be inclined to adopt so sweeping an alteration in the present state of things, that was the argument which Sydney Smith put into the mouth of the noodle some 40 years ago, and it was altogether out of date at a Society of Arts Conference. If they said it would cause trouble and inconvenience to certain proprietors, the same argument might be advanced against any measures, either of this or the late Government. The very Act they had just amended, to his immense satisfaction, was intended to cause a great deal of trouble. If, on the other hand, it was said that it would be creating invidious contrasts throughout the country—you will have one house marked A 1,100 over the door, and the next house without any certificate whatever, and is not that creating a sort of invidious contrast?—he should reply, it was just the same contrast which existed between a virtuous man and the knave; between the man who endeavoured to do his work well as a builder or contractor, and the jerry builder, who, as they had heard, scamped everything unless he was strictly watched. He could not see that that objection should have any force. But there was this to be said, he was sure that there was a very large class who, as proprietors of houses, would be delighted to have some satisfactory assurance for themselves, as well as their tenants, that the work they had paid for had been well done. In the next place, there was a large class who were very anxious indeed to have some trustworthy source of information to which they might go, when they wished to take a house or buy one, and receive information on the subject which affected the happiness and the health of their children. In the third place, he was told that this measure, if it should even have the fortune to go from that room to a higher and larger arena, would be supported by every first-class builder and contractor throughout the kingdom who honestly wished to fulfil his duty, and to do his work satisfactorily, and who would only be too glad to have some tangible certificate that he had done so. He was assured also by competent men, that there were many men and women seeking information on this subject of such vital importance to themselves, which, unless they were willing to incur the expense of employing some of the many admirable and respectable sanitary engineers, they could not arrive at; namely, whether a particular house was health-worthy or not. If it were necessary to make a ship seaworthy before you admit passengers on its deck to go to sea, there was a paramount and parallel duty on the part of the builder to make a house health-worthy for those going to live in it. He was told by the Press, who had done him the honour to take notice of this matter, that if they once commenced this career of enabling men to obtain a certificate that they had

done their work well, keeping their houses healthworthy in accordance with the dictates of science; and if they could offer some practical evidence that they had so done their duty, the value of the houses would be considerably enhanced. The question, therefore, was, why should they refuse a boon offered to them on such simple terms. What were those terms? He did not ask the City to give a subsidy or to assist in a matter which was well worthy the consideration of the Chancellor of the Exchequer, but simply that it should be self-supporting. With reference, first, to new houses; he would assume a man was desirous of building a house in a manner such as even Mr. Rogers Field or Mr. Eassie would approve. He sent for an expert—an officer of a public body—and said, I am told such is a proper mode of drainage; I am told by the model bye-laws that I must avoid certain evils; I must construct a house in a particular way; will you be kind enough to watch the operation, and give me the benefit of your supervision over the contractor, and tell me what your charges are. For the sake of argument, I will assume he would say two guineas—depending upon the character of the house, whether it would be two, five, or ten guineas—before the drains were closed in. He asked him to come again, and he entered a note in his memorandum book, that so far as the foundations, &c., were concerned, they are in conformity with the rules laid down for his guidance. When the house was approaching completion, he would see whether the water-closets were in their proper place, and the drains properly constructed, and all the leaden pipes and everything else properly jointed. Eventually, when the roof was laid on, he gave another certificate, and the probabilities were that, in certain houses, the whole expenditure would be ten guineas. That certificate would be "that the house was health-worthy," sanitarily equipped, so as to afford the best possible opportunity for the people going to live in it to enjoy the advantage of health. He put that in the form of a document, sealed with the authority of the public body, to which he should subsequently allude; and the happy owner of such a house included the certificate amongst his title deeds, as good an assurance as any other he had. When he sold the house, he handed it over; and when he let it, allowed the intending tenant to see it, and ascertain whether it was fit for habitation. House agents told him that one of the first questions in London and other large cities, such as York, Manchester, and Leeds, by the intending tenant was—"Is the drainage all right?" and the answer was, "Oh, yes, Madam, of course." No doubt he answered to the best of his information. "When were the cesspools emptied?" "I think they were emptied within the last three months." "Shall I employ a surveyor?" "I think it is hardly necessary." Perhaps the tenant hesitated, like a friend of his did, who went to consult his lawyer, and said, "Do not you think it would be advisable for me, before I take that house down in the Thames Valley, to have it investigated, to see if the drainage is all right." "No," said the solicitor, "If you were going to buy it, I should think it would, but as you are only going to live in it, it does not much matter!" Now came the question, what body should command this position? When he wrote the letter to which he had referred, he first suggested the Society of Arts, because he thought it deserved, if it did not receive, the confidence of everybody throughout the country; and that the Council, composed of eminent men, would be a guarantee to the public that they would not listen to any insinuation or suggestion of corruption. On further consideration, however, he found it would be somewhat beyond the scope of that Society, and he was not surprised when he received this letter from Mr. Stansfeld, which, with his permission, he would read:—

Stoke-lodge, Hyde-park-gate, W.,
May 22nd, 1879.

Dear Mr. Cresswell,—Your idea appears to me extremely well worth threshing out with competent persons. My feeling is that it is too big for the Society of Arts to take up, without first sounding a few picked men amongst architects, sanitary engineers, surveyors, and builders, resulting possibly in a select Conference on the subject. I am not sanguine, but I think the idea is good, and that it could not but do good to "ventilate" it.—Yours truly, J. Stansfeld.

Encouraged by that support, which bore conviction to his mind, and would, probably, have great weight with the Conference, he nursed the subject, considered it in its various bearings, consulted eminent men, and found the idea approved by them. He had the honour of an appointment with Mr. Stansfeld some time ago, to further consider the question, and that led to the insertion of No. III. in the programme. They would at once see the importance of handing over these duties to such public body or bodies as would command undivided confidence; that there should be no possibility of collusion between builder, or contractor, engineer or sanitary expert, employed by the association or public body; that there should be no doubt whatever that the same repute should attach to the certificate issued from this public body, as attached to a certificate of Lloyd's; and he could not put the case stronger than that; for, at that moment, the well-known "Lloyd's Register," bound in blue and gold, bearing the certificate of their secretary, was accepted throughout the whole civilised world as an indisputable evidence of the truth of that which it contained. Some of them might live to see—they, no doubt, all hoped to live to see—the time when there should be such a book in the hands of every municipal authority throughout England—in the register or in the archives of every local sanitary authority in the kingdom; and above all in the archives or secretariat of the metropolitan authority—whatever it might be in the future—which was destined to govern this great City. If that were so, they would have palpable and tangible evidence of the fact, the means of ascertaining whether the houses in which they had to dwell were fit for human habitation. In the case of the metropolis, whatever the metropolitan authority might be, it should be charged with this most important function; and as they all hoped to see within a few months time the institution of County Boards throughout the kingdom, no better authorities could be found—as they were above suspicion—to perform a similar function in the counties. That was, in fact, the substance of the proposition he had now the honour to lay before the Conference. He submitted with confidence that it was at least worthy of the Society under whose hospitable roof they were, and worthy of their attentive consideration.

Dr. Wright said, as representing a town peculiar in its character, namely, Cheltenham, to which a great number of particularly timid and nervous people came to take up their abode for the purposes of health, it was astonishing how nervous these people were on this particular question of the condition of house property. He had letters, some even from India, making inquiries about certain places. Of course, as an Officer of Health, he could not interfere with the rights of private property. He could not say all he knew about houses; but he gave those individuals references to a sanitary engineer to whom they could apply, and who would make an inspection of the houses. That had been going on for some time, and, of course, sometimes the reports were unfavourable, and there was a threatened action for damages against the man who had spoken the truth. But altogether it appeared to him that what Mr. Cresswell had so well put before the Conference was neither more nor less than the outcome of what had been going on of late years with reference to sanitary progress. They had awakened the attention of the public mind, by trying to teach them the alphabet of sanitary science, and they were now beginning to spell out the words for

themselves. Now came home to every one the important question—Is the house I am about to take healthy or otherwise? But when the inquiry was made, there was great difficulty in arriving at a conclusion. Very often the most intelligent persons had suggested the want of the very resolution which Mr. Cresswell had so ably introduced, and which he should be very glad to propose, be adopted by the Conference. If this system was once inaugurated, there would be no difficulty in getting people to submit their houses for inspection. To show how persons disliked being behind-hand, he might point to the "Sanitary Record;" a short time ago, when the monthly reports first appeared of statistics throughout the country, there was great backwardness in many quarters; but as soon as the blanks were pointed out, the pages began to be filled with records of the sanitary condition of some of the first towns in the kingdom. Persons who had good property would wish it to be known, and persons having inferior property would take care to have it improved, so that it might occupy a better position in the market.

Dr. Tripe pointed out the difference between ships and houses, especially as regards the sanitary condition and fitness for habitation of such dwellings, which were so great that, to certify for a term of years that the house would be fit for occupation, was certainly ill-advised. If the words, "for a term of years," were omitted, he should have comparatively little objection to it. Those who knew much of sanitary work were aware that the lead-pipes leading from the water-closets got eaten through; holes were made in them, and it could not be told from the quality of the lead how long they would last. They did not know the reason why certain pipes should be eaten away, and others remain whole. It was, therefore, impossible to give a certificate to the effect that the house would be in good condition for a certain number of years. As to a house being put in the first, second, or third classes, and certified accordingly, he could understand that. He had seen a great deal of building, and gave evidence before the House of Commons on bad building. He had analysed a large number of samples of mortar used, and had found mortar, even recently, made with only 10 per cent. of lime, the greater part of the rest being—he would not say rubbish, —after Mr. Cresswell's definition of the word—but garden mould, or something no better, and the consequence was the houses fell down. The inspection of these things was entrusted to officials appointed by the Metropolitan Board of Works, and it was now proposed to appoint others. Were they to have one set of men appointed by the same authority to supervise the other? He could not agree to that; you must find some other body.

Mr. Cresswell said they were the district officers.

Dr. Tripe said the persons to superintend the drains were persons appointed by the Vestries and Boards.

Mr. Collins said the district surveyors were appointed by the Metropolitan Board of Works, and they had nothing to do with the drainage.

Dr. Tripe said that was exactly what he meant. The surveyors appointed by the Vestries had to superintend the drains, and the district surveyors appointed by the Metropolitan Board of Works had to do with the walls, the damp-proof course, the foundations, the roof, and other things of that kind. The water-closet arrangements, and all works connected with drainage, are in the metropolis under the control of the Vestries and District Boards. It was said that no Vestry or District Board had any regulations, but he would hand in some, framed by the Hackney Board, showing that one Board, at any rate, had regulations concerning matters of drainage. There was plenty of power, in fact, both as regards district surveyors and surveyors to Local Boards, to prevent bad work. They could require anything reasonable to be done, as the bye-laws of the Metropolitan Board were extremely full if they were properly carried out. For what reason should there be any addition to these, or why should a person have perhaps to pay again the officer who was already paid, to see that things were properly done at first. As he had already said, he had analysed mortar containing only 10 per cent. of lime, which, when put into the crucible, turned red from the quantity of clay it contained. That was not in accordance with the bye-laws of the Metropolitan Board. He had ascertained the quantity of organic matter in it, and, when mortar was made containing organic matter, it gave off a smell sometimes for six months. That caused a gradual crumbling; so that, although apparently good and setting well, it would by keeping, even in a dry room, in the course of time become perfectly rotten. This kind of mortar is used to a considerable extent by "Jerry" builders. He quite agreed it was most important that persons wanting good dwellings should be able to know where to get them; but here was the difficulty, that persons must be engaged *ab initio*, or they could not tell what was underneath the house, and whether the drains were put in in concrete or not. In Hackney, every drain going under a house within three feet of the floor was to be in concrete, and every drain was supposed to be examined, two men being appointed for the purpose; but, of course, he did not know that they did do so, as they were not under his control. He believed that every house, so far as the drainage was concerned, was examined; but he could not say what was done with the walls and foundations, and everything of that kind. These you could see afterwards, but as for the drainage, and what was buried under the ground, you could not see without considerable cost and trouble. Therefore, in order to carry out this proposal, there might be something done by calling the attention of Vestries and Boards to the fact that they had full power to make bye-laws—which very few had done—and to insist that they were carried out; that no drain should be covered over without the surveyor or his representative seeing every portion of them, and that every drain under a house was laid in concrete. If this were carried out properly, they would not hear so much as they did about bad drains; and if the attention of the Metropolitan Board of Works were called to bad buildings, whenever they were seen to be going on; if every one knew the law, and would act as a kind of inspector in the matter, they would get better buildings, and even such a proposition as this would not be required as it is now. He strongly supported the resolution, but objected to the new officers being appointed by the Metropolitan Board.

Mr. Nichols, C.E., asked for some further explanation as to the term of years.

Mr Alcock said, supposing the inspection took place, everything was in order, and the certificate granted the house was A 1; and then suppose a gentleman came in who did not like the arrangements which had been made, and determined to alter them very materially, and made those alterations without inspection, where was the value of the certificate, and how could that be rgulated? He sympathised with the resolution, but thought there were many difficulties in the way.

Dr. Yeld said, suppose a certificate were given, and a tenant took the house, and subsequently found there was a defect, from which a member of his family took typhoid fever, what remedy would he have against the man who gave the certificate?

Mr. Cresswell said, as to the term of years, it was only detail; and, although he thought it important, the resolution would be equally good without it. Ships were registered for a term of years, according to the quality of the timber and character of the work bestowed upon them, but were

afterwards subjected to periodical inspection by Lloyd's surveyors, who had to report at the end of every voyage whether the ship maintained its character. It was possible a ship might have gone a-ground without the fact being communicated to the underwriters or Lloyd's, because it was not considered of sufficient importance, or there might be some fraudulent purpose for concealing it. To keep it in its class for a term of years they had a certain control over it; it was for the interest of the owner as well as for the public that it should be so. With regard to houses, they wanted to acknowledge a principle, and, if it were good, to ratify it, and then to get the benefit of the collective knowledge and experience of those assembled, so as to improve it. He could see at once the value of this Conference, because it enabled him, not only to learn the grooves in which men's minds were working, but to be prepared for these objections. The question of the term of years was merely relative. If, as Dr. Tripe said, buildings were very badly constructed at first, and the mortar itself only lasted three or four years, it would be ascertained at first by inspection, and the probabilities were a certificate would only be made for two or three years. If, on the other hand, you had a house like Lord Spencer's, on which large sums of money had been expended to make it quite a palace of health, very probably the inspector would grant a certificate for a much longer term of years. The question of terms might be omitted if it were in the slightest degree a stumbling block. Mr. Alcock had put the crucial question as to what remedy you had if, when a house had been made thoroughly health-worthy, a man became the tenant who destroyed the whole of that work to satisfy some crotchet of his own. The remedy was to send him to Hanwell by Act of Parliament, and the means of discovering whether that man was fit for Hanwell or not were at hand. In a policy of insurance, you had first a contract between the underwriters and the owners, which was very simple, but on the back of that there was a long list of closely printed conditions, which made that which was simple most complex, and defined, according to the requirements of the Mercantile Marine, and the experience of the last 100 years, the various conditions under which that policy was to take effect. Now, what would be easier than to put a condition on the back of a certificate, that if a man parted with a house he should give notice to the authority, so that the incoming sane man should have the benefit of further confirmation of it, and that the insane man should not be permitted to work his will to the detriment of the public. Then the question was, what remedy would you have against the public body, by way of compensation, if a case of typhoid fever arose in a house which had been certified. If there had been some hidden latent defect which had escaped the vigilance of a man, like the gentleman who put the question, in inspecting the house, there would be the same remedy as a court of law gave everybody, or the Government would be called upon to give to anybody under the same circumstances. If you could show that it was wilful negligence, or that the public body employed entirely incompetent men, the Metropolitan Board of Works, unless protected by the Act which would bring this proposition into force, would be responsible for the act of their servant; it would be just as responsible as any other public body would under such circumstances. It was impossible to alter the common law of England, but if there were fear or apprehension of such a state of things, a provision in the Act, which, he trusted, would be passed in the future, might easily remedy that. You would have to show satisfactorily, in the first case, that the typhoid fever arose from that defect, by calling in Dr. Frankland on one side, with his germ theory, and Dr. Tidy on the other, with his anti-germ theory, or any of the eminent men he saw before him, to give their various views and scientific opinions as to the origin of typhoid fever, and he could fancy that an able counsel would handle that before a jury with some facility. Then, supposing you proved it was typhoid fever not imported from another house, where you had been dining with a friend who had not taken the same precautions as yourself, you would still have to prove it was a discoverable defect. The law books were full of such cases, and the whole question would turn on this, whether it was wilful default, which entitled you to redress or to a remedy, or whether it was one of those *force majeur* cases of which they heard so much, which even the most perfect system of civilisation must produce.

Lord Alfred Churchill said amongst the very valuable suggestions which arose from these Conferences, he thought there were none likely to perform so much good as this, which had been so eloquently propounded by Mr. Cresswell. The condition of people's dwellings really lay at the root of the question of public health. He should be glad himself, as soon as such a thing became law, to have his house inspected, and to get a certificate upon it. Four or five years ago he had the drains put in order, and should have been glad then to have got a certificate that they were so. Whilst the work was in progress, he casually met the inspector of the district, who told him he had watched the laying of the drains, and he said he was very glad they made such a rule that the drains were not to be closed in until they had been inspected. The inspector said, although they did in his case, they were not in the habit of doing it to everybody. Now, he thought it was absolutely necessary that it should be done in the case of every house. With regard to Dr. Yeld's question, he thought the health-worthiness of a house depended almost entirely upon the system of drainage, and the certificate should be that the house was examined at such a date, the drains were laid according to the most scientific methods known at the date, and calculated to last such a time; not giving any certificate of health-worthiness, because that was the natural result of good drainage. He would suggest that the certificate should be in the form that the drains themselves were constructed in a proper manner, and were calculated to last so many years. He thought the drains they saw yesterday might have a certificate A 1 for 100 years, and there should be attached to each certificate a complete drawing of the way in which the drains were constructed, in the same way as an outline of the property was generally shown on the deed of conveyance.

Mr. Collins asked if the army of inspectors necessary to carry out this suggested work of inspection had been considered. He had for many years taken a great interest in these questions, and was on many committees in the parish of Paddington, which is a very large and wealthy portion of the metropolis. As had before been mentioned, he considered the Metropolis Local Management Act gave all the power necessary to enable Vestries to see all that Mr. Cresswell wished carried into effect; but, whenever you brought such matters forward, a storm was at once raised as to the large amount of money it would cost, and the incubus it would be on the ratepayers in order to get such a system carried out. If it were self-supporting—if the public were so alive to the question as was hinted—there was nothing at all to prevent them obtaining, without the aid of the Society of Arts, without the assistance of Government, or any similar means, such certificates as were referred to. There were many gentlemen, eminent in their profession, quite capable of giving such a certificate. The truth was that, like most permissive legislation, it would be simply a dead letter if it were passed. There were very few people who, like Earl Spencer, could afford to go to the large expense which such a system demanded. He could only say, from his own experience as a sanitary architect and engineer, that he had always found that when

mischief was discovered—as during the prevalence of fever—everybody was anxious to do all that was requisite with regard to sanitary improvement; but, the moment the epidemic passed away, there was great apathy, and very little was carried out. This question was by no means new. At the meeting of the Social Science Association held at Brighton (to the health department of which he had the honour of being secretary) this subject was fully discussed, and the result of it was, a large number of circulars were sent round to the different sea-ports and towns, for the purpose of ascertaining how the authorities would fall in with views very similar to these. He believed 400 or 500 circulars were sent, and about 20 or 30 replies only were received—showing how great was the anxiety on the part of the public to carry out such a suggestion. In Edinburgh, Manchester, and Glasgow, companies had been formed for the purpose of giving such certificates, but he did not think they had been in existence more than one or two years, and therefore it would be difficult to say practically how far they had succeeded, but he should like to know what dividends they were paying, and how far the sanitary rules laid down in this resolution were found beneficial. He thought it would have very little effect indeed. If a man really wanted his house put in proper order and condition, there was no difficulty in obtaining such a certificate; and if the Conference wanted to throw the onus on local authorities, he was perfectly certain they would not carry it out, even if it were paid for. He should like to say a word in defence of his own profession; as a district surveyor for an important part of the City of London. The Act of Parliament gave no option to the district surveyor (until very recently) to attend to sanitary regulations, as connected with the building operations in the metropolis. His duties were to ascertain that the walls were built of sufficient thickness, and that certain precautions were taken with regard to accident by fire. Recently, and after an enormous amount of opposition, the Act having been passed two years, certain bye-laws had come into operation which were very simple indeed, and which, by-and-bye, people would be astonished to find had taken so lengthened a period to adopt; but these simply provided that there should be damp-proof courses and proper foundations to the houses; and therein all the sanitary bye-laws of the Board of Works began and ended. A great many more were prepared, but there were so many objections raised, and selfish interests alarmed, that the whole thing threatened to collapse, and they only succeeded in carrying what he had referred to. They did get, it was true, a definition of mortar, but it still only remained a definition as far as his experience went. There was the greatest possible difficulty in obtaining these "jerry" builders to perform their work properly. Even if this duty of giving certificates were placed in the hands of inspectors of health, or Vestries, or Local Boards, from his knowledge of the subject, he thought there would always be a certain amount of suspicion attaching to them. The only way of carrying these views into practical effect was to get the public mind sufficiently educated to the necessity of seeing that their houses were fit to live in, and not to die in; and then they would take proper means of availing themselves of such professional assistance as was open to them, in order to insure that their houses possessed those healthy conditions which they desired.

Mr. Alcock suggested, as an amendment, to strike out the words, "health-worthiness in different categories," which he did not think would at all injure the effect of the resolution, and also the words, "for a term of years." If they could show that a house was built properly, that was all the inspection and the certificate need show. If the suggestion thrown out by Lord Alfred Churchill were adopted, that would meet the difficulties he had raised; and if it were accompanied by a plan showing the drains, closets, and gullies, anybody looking at the certificate, and seeing the plan could see whether the place had been so entirely altered as to require a further inspection and certificate. There was nothing more necessary than for the owner of a house, or the sanitary authority, to have a plan of the drains of the premises; because if anything went wrong, as a rule, nobody could tell where the drains were.

Mr. Cresswell said he could save the time of the Conference by at once accepting the suggestion. The words "health-worthiness" was only used as an illustration as being analogous to seaworthiness in a vessel; it was not in any way essential to the proposition. With regard to a plan on the back of a certificate, it was always intended it should be so, and it was one of the most important elements of the whole question.

Dr. Vacher thought the words "in different categories" should come out. A house was sound or otherwise, and if you were to say it was pretty sound, or tolerably sound, or tolerably healthy, it would mean nothing. You must have a minimum standard whether a house was healthy or not.

Mr. Owen said the resolution pointed to empowering the Metropolitan Board of Works and County Boards to undertake this duty, but would not be expedient to include the municipal authorities of cities.

Mr. Cresswell said of course that was for Parliament to decide. All he wanted was a permissive Act, in the first place, though in the course of years it might be made compulsory, as was the case in all legislation. It would be simply an enabling Act, which would enable certain bodies, for the convenience and safety of the public, to issue a certificate of fact, about which there could not be any doubt.

Mr. Wakefield was entirely in favour of this proposition. It had been in his mind many years, and there was no way of getting the public to adopt sanitary measures, except by making it a question of self-interest. You could not do it in any other way but by a system of certificate, but the question appeared to be surrounded by some difficulty. It would be almost too onerous a duty to impose upon local functionaries. The task would be so invidious, if called upon to withhold a certificate, the withholding of which would be to inflict a serious injury on the proprietor, that there would be such an amount of pressure brought to bear on the officers as would be hardly fair to subject them to. He could not see his way out of it, except by having a special officer appointed by the Local Government Board in London, and even an officer of that kind ought to be bound down by the most stringent rules. It was not only the drains, but the walls that were of importance. It was impossible to have a good house if you had lathe and plaister in it at all, and all the walls should be able to bear a certain amount of surface-pressure without yielding. If a system of that kind could be carried out, the value to the public in general would be incalculable. Take a case for instance; he knew a first-class school, where the children of noblemen were being educated, where typhoid fever broke out again and again. Nothing wrong could be discovered in the sewers, but on examining the walls it was found that 40 papers had been pasted one upon the top of the other, and, in fact, two large waggon loads of old paper was taken away. Lodging-houses and hotels, again, of superior character, would be very glad to use this system as a means of attracting visitors.

Dr. Richardson said he should be very sorry if anything went forth from that Conference, which would lead to the impression that the adoption of the resolution would cause those difficulties, which Mr. Cresswell had spoken of, with reference to the different views of the medical profession as to the sources of fever, and the various theories which were now put for-

ward to explain the origin of that disease. If the litigation spoken of were to be the necessary result of passing such a clause as this, the cost of carrying out such inquiries would be overwhelming. In fact, when you come to consider the question of the origin of typhoid fever, there is something extremely difficult in the analysis, from the fact that the most careful could not arrive at a conclusion in many cases. Within the last three days, he had seen a case of typhoid in a very unhealthy house; and no doubt, any one carelessly seeing it, would immediately say that the cause of fever was in the house; but by going thoughtfully into the history of the person previous to the occurrence of the disease, it was perfectly evident that he was miles away from that house when the fever was contracted, and merely came there suffering from it. These difficulties would be always springing up, and, therefore, he trusted nothing would come out of this discussion which would lead the public to the conclusion that this resolution would cause legal inquiries of that character. He quite agreed with what Lord Alfred Churchill said, that the best plan would be that there should be a certificate to record the condition of the house at the time of inquiry, and no more, so that, whatever might occur afterwards, the unhealthy condition would be traced from the time when the inspection was made. One other point must be impressed on all governing bodies with regard to carrying out such a clause; viz., that there should be some distinct set of rules as to the condition of a house, which rules should be the basis on which reports should be made. If it should ever fall out that mere individual opinion became the expression of an absolute rule that was to be acted upon in individual cases, there would be as much contention as if a number of doctors were brought into Court on different sides, to determine the origin of a fever. An abstract rule should be laid down, on which certificates could be based, and could, in course of time, be changed, either say at the end of 5, 10, 15, or 20 years, when something new had been truly made out, and when the actual condition which warranted the granting of a certificate would have to be changed. Meanwhile, there would then be something fixed on which inspectors could rely, and certain data given to them on which to grant the certificate. With that feeling, he should vote for the resolution, but would strongly recommend that the suggestions already made should be carried out. He was a little in doubt about Dr. Vacher's suggestion respecting the omission of the words "in different categories;" on the whole, however, he thought they had better be left out.

Mr. Lovegrove thought it expedient, if practicable, to have certificates such as were referred to in this resolution, but the question was surrounded with difficulties. He had no faith whatever in any certificate, whether it had blue or red ribbon upon it, whether a gilt edge or not. What was wanted was more than thorough supervision during the progress of the works, for there were miles of drains which appeared on the face of them perfectly sound, but which possessed qualities of unsoundness, which might prove after ordinary inspection a great injury to the inhabitants. They wanted, if they could, to get hold of the hand from which they could obtain sound workmanship, for we depend more on the hand that works than upon occasional overlooking. They wanted drains laid by educated workmen. In the Hackney district, the Local Board executed the work outside, from the sewer to the area, under contract, but from that point underneath the houses throughout to the back, the work was executed usually by the builders. Sometimes there were as many as five or six different workmen engaged on that section of the drain, and the time over which the work extended would be from one month to seven or eight. There we have one of the most serious difficulties in superintending the construction. In order to insure perfect construction of the drain, the whole of the work, from the sewer to every inlet, should be executed by one, and a properly constituted authority, and not left to the builders. He had on former occasions referred to the question of certified workmen, and he thought if they could have a class of workmen educated to do this particular work, it would be a step in the right direction. In the absence of that, he should suggest that the whole of the work should be executed by the local authorities at the cost of the owner, but he should object to the Metropolitan Board of Works being entrusted with the power of surveying the work done under the local authorities.

Captain Galton thought it would be very undesirable to pass any resolution which would not be of a practical nature. Although he entirely sympathised with Mr. Cresswell as to the desirability of adopting some means for securing that houses should be constructed in a manner which should insure their healthiness, he had very grave doubt as to how far this mode of effecting that object was practicable. It went to the extent not merely of the drains, but of the whole sanitary character of the houses; it included the nature of the materials, the walls, the ventilation, and the mode of construction of the basement, the means of saying that the house was not being built upon a foundation which was in itself injurious to health, as the foundations of so many houses in London were. All these were points which, if you were to have a certificate of healthiness of the dwelling, must be examined into by the authority which was to deal with it. It seemed to him it would be far wiser to pass a resolution similar to what, no doubt, had been passed before, that all plans of drains, and the sanitary appliances of all dwellings, as well as all alterations in such matters, should be registered at the office of the district surveyor or Vestry, and that any person wishing to take a house should be able to examine this plan. The fact was that the arguments which had been adduced on this subject pointed really to the necessity of an improved education of the whole nation in sanitary matters; it was that only which would insure a healthy construction of houses. It seemed to him that it was going entirely beyond the powers of any body which could be found, to compel people who did not appreciate the value of sanitary appliances to adopt them. Nothing could explain this so well as the speech of Mr. Wakefield. He argued that what was wanted was that every detail of the house construction should be subjected to some Government authority, but that was an absolute impractibility, and, consequently, a *reductio ad absurdum* of the argument. What they had to aim at was to educate the nation in sanitary matters, for until you had done that you never could have really healthy houses.

Mr. Rogers Field entirely concurred with Captain Galton. He thought the resolution, as it stood, could not possibly work. It referred to certificates for old houses as well as new houses; but he was quite certain that certificates could not be given for old houses. The amount of investigation which would be required, if the certificate was to be worth anything, would be enormous, because, in an old house, you must examine everything, open everything, and search everything; if you did not, you would be certain to miss something which was very faulty. With new houses it was different, but then they came to what Dr. Richardson had said, you wanted, first of all, a standard to work by; and, at the present moment, they had not got that in the metropolis. You might go with a scheme of sanitary arrangements for a house, proposing what every man who had studied the subject would agree was the right system, but the Vestry would very likely think differently. The question of cutting off the house from the sewer by a ventilated trap, or man-hole, was most important from a sanitary point of view; but, when he proposed to do that, one of the West-end London Vestries said "No," and raised all sorts of difficulties. Until this state of things was remedied with the

Vestries, it was impossible to go any further. If proper bye-laws for house drainage were introduced, you might have a certificate saying that the bye-laws were complied with; but, unless it were done in that way, you would get into difficulties.

The Chairman said they had already assumed that such powers should be taken.

Mr Rogers Field said then you came to this point: What was proposed here was that the Metropolitan Board should issue these certificates; but, surely, they ought to be issued by the same body who was responsible for the bye-laws, the body which would have to make the bye-laws; that is to say, the District Board, or Vestry, as the case might be. He did not think it would do to have certain bye-laws made by the Vestry, and the Metropolitan Board to come in and see whether they were carried out.

Dr. Bond said the last speaker and Captain Galton appeared to overlook the fact that these certificates should be certificates of fact, as to the actual constructive details of those parts of the edifice which were included in the certificates. He apprehended they should be so drawn that they should include all the principal points to which reference had been made; but, where the person certifying was unable to ascertain what was the nature of the particular construction, he would simply fill it up by an entry "no information," or something of that kind. With reference to the objection that Mr. Field had made, that such certificates could only be obtained at a cost which was prohibitory, that was simply a question for the owner or occupier of the house; it was a question of demand and supply. If they wanted that which could only be obtained at a cost which they could not pay, they must do without it. There was no scheme worth anything which had not a difficulty connected with it, but they were all agreed that the advantages were so great that it was at least worth while to make the experiment, and, as so much of our sanitary legislation had been tentative in its character at first, and experimental, so as to give local authorities the opportunity of ascertaining practically whether the ideas, which were at first theoretical, were really practically, this was also one of those cases in which this permissive power should be given. There was only one point of difficulty, and that was there might be a great practical difficulty in operating over such a large district as a county, unless the authorities had power to appoint as many officers as might be necessary. He had been instrumental in establishing an association of this kind in Gloucester, but it did not work quite so satisfactorily as it might, because the place was not large enough to support it.

The Chairman said he had made some verbal alterations in the resolution, which he thought would improve it, and it would now read as follows:—

"That it is expedient that the local authorities should be empowered by the Legislature to make provision for the inspection of dwellings on a defined system, upon application being made by the owners thereof; and to grant certificates, according to the perfection of sanitary equipment and fitness for habitation of such dwellings, accompanied by plans of drains, closets, and gullies, &c.; and to determine the scale of fees to be paid for such inspection during construction and repair or otherwise, and also upon delivery to the applicant of the certificate awarded to such dwelling."

Mr. Smallpeice, C.E., said nothing had been said as to the men who were to be appointed inspectors, and what qualifications they should possess for their office. The Public Health Act gave power to urban and rural sanitary authorities to make bye-laws containing every provision required in this proposition. It empowered them to appoint inspectors or surveyors, to see that those laws and bye-laws were carried out, but there was no qualification required for those surveyors. He had a letter some time ago from Sir John Lambert, stating that there was no qualification required by the Local Government Board for a country surveyor, any more than the Guardians might require. In London, every district surveyor had to undergo a special examination, and show that he was fitted, before he could obtain the office, but in the country any person who could get a majority of the Guardians was appointed. Now, it was evident that a certificate would be valueless unless the surveyor had undergone some examination as to his qualification to perform his duties.

Mr. Pearce thought this resolution was not calculated to remedy the evils complained of, yet it was likely to be operative to a considerable extent in deterring builders from putting such bad workmanship and materials into houses as they had been in the habit of doing; therefore, apart from the benefit which would accrue to those who might be fortunate to live in a house certified to be healthy, its indirect influence would be very great in removing many of the evils from which they at present suffered. Some houses which were condemned as being absolutely unhealthy had been constructed under inspection, both as to materials and workmanship employed; it should be made more of a reality. He spoke on behalf of house occupiers and owners, and thought it would be lamentable to have to leave this question until the public generally were educated in sanitary science. As a rule, house occupiers could not give much attention to this matter. Houses were largely built by speculative builders, who were merely anxious to get them up, certified to be habitable, and sell them, and the public looked to the authorities to protect them against these evils.

General Cotton, referring to Captain Galton's remark, that little could be done until the nation were educated in sanitary matters, said he could imagine nothing so instructive as these certificates handed from one to another, and compared with one another, showing why one house was A 1 and another B 2.

The Chairman said he was sometimes told by his friends that he had something of the judicial element in him, that he did not go to extremes; but, upon this subject, he went further than the resolution. He supported the resolution, because he agreed with Dr. Bond that it was a good tentative educational way of going to work. It pointed out the functions and duties of local sanitary authorities, and the obligation they had undertaken with regard to the ratepayers of the district who supported them, and whose actions they, in some respects, controlled in the building of the houses. The local sanitary authority made bye-laws, and the duty imposed upon it—as it assumed to itself the right of laying down rules as to the materials of which houses should be built, the method of construction, and so on—placed it before the ratepayers as a body which existed, amongst other things, for the purpose of securing healthy dwellings, at any rate in future. That was the duty imposed upon it, and the duty which it had taken upon itself to carry it out. Now, taking the question of drainage, the local authority constructed a sewer, and told the house owner to drain into it, and they had already arrived at the view that every local authority ought to have at least as much power as the Commissioners of Sewers had in the City of London, because if the local authority constructed the sewer, and told the owner to drain into it, it was on the ground that it had a right to compel the owner to dispose of the excreta of his house, and send them down the drain to be carried away, so as not to be a nuisance either to those in the house, or in the neighbourhood. On the other hand, their obligation was not to send back sewer gas into the house; but the local authority could not fulfil that implied contract unless it had control, first of all, over the conjunction of the drain with the sewer just outside the house; and, secondly, it could not fully fulfil

that contract unless it had some knowledge and supervision over the drains and similar arrangements of the house. The same remarks applied to the supply of water and gas. In many towns these were supplied by local authorities, and where they were not, they were supplied by companies by virtue of law, but it was surely part of the duty of the local authority, or it should be, to see that water and gas were supplied under conditions which were consistent with the health of the population. Practically speaking, what a condition of utter helplessness were people in when taking a house. Take an inhabitant of South Kensington, it was a matter of notoriety that a man might go and buy, or take for a long term of years, a house, and he had no guarantee that there was any connection between the drain and sewer at all; and in many cases, even after the experience of illness and death in the house, he had at great expense to have the floor and basement of the house taken up, and then to have the road taken up to the sewer in the middle, and find there was positively no connection at all between the house drain and the sewer itself. That was too dangerous a state of things to be permitted, and it was part of the duty of the authority to prevent the possibility of such a fraud. If you had introduced in the house drains or water supply, or anything of the kind, as covered work, you were at the mercy of your tradesmen; you had no plans, you did not know anything about drains, the pipes all over the house were left out of view, there were no means of knowing where they were, so that the householder, whatever his general education and intelligence, was helpless in the hands of the tradespeople who lived by this kind of work. He was prepared to go to this extent, when he introduced the original Local Government Act. There was one whole chapter which he had to put aside in order to pass the machinery of the Act, which was most important, and, amongst those clauses which he was gradually gathering together, there was one which no one had the courage to propose except himself, but he was to have been allowed to propose it on his own responsibility. He called it in his own mind the Florence Nightingale clause, because he had some conversation with the lady on these subjects which impressed him very much. She presented to him what was at the time a new view, and it struck him immensely. The ordinary view was that an Englishman's house was his castle, and the idea was, do not let the local officer come into the house, keep him outside; let him attend to the sewers and drains, but he has no right to come into the house. Miss Nightingale said it was not a question of right, but of duty; I, as owner or occupier, or any person who proposes to buy, want to know whether a house is healthy; some inconvenience occurs, some evidence of its imperfection and unhealthiness, and I want to find out what it is; I cannot find it out by going to the local tradesman; very likely he is ignorant, or, at any rate, he will make a job of it, and that will be the whole of his object. I ought to be able to go to the local authority, and say it is your function and your duty to look after the health worthiness of this house. You compel me to drain into your sewer, and you are bound to future occupants of the house to show them by plans the nature of the connection between the drains and he sewers. The same remark would apply to the supply of gas and water, because the imperfect supply of gas and water have a great influence on health. In his opinion, therefore, in future it would be advisable and perfectly just, to throw on sanitary authorities the duty of preserving plans of all these communications between the interior and the exterior of the house. He did not at all mind their making some reasonable charge to cover the expense, but it ought to be considered as part of their duty in the future to do so. In the meantime, he thought Mr. Cresswell's suggestion, and the alterations which had been made, were very useful and worthy of adoption; it was simply permissive, and though he was not very fond of permissive legislation, it was sometimes not a bad mode of leading the way. It was of an educational character, and might be followed by something stronger and more compulsory in future.

The resolution, as amended, was then put, and carried unanimously.

The Chairman then invited discussion on head 4—"Further suggestions by sanitary authorities."

Mr. Alcock said there was one point he wished to say a word or two upon—the question of the limitation of time for interference by the sanitary authorities in connection with the Public Health Act. They were now limited to six months within the time of the offence charged having arisen, but experience showed that very frequently, in consequence of that clause, they were unable to proceed at all, because the six months had elapsed, or very nearly so, before any intimation of an offence having been committed was conveyed to the sanitary authority. He would move, therefore, that it was desirable to amend Section 252 of the Public Health Act, 1875, so as to extend the time for taking proceedings to twelve months or two years after the committal of an offence, or at least six months after the offence was discovered, and brought to the notice of the authorities.

The Chairman said he thought that would be at once agreed to, and the resolution having been put, was carried unanimously.

Mr. Parrish said by the Public Health Act, section 70, bye-laws might be issued by local authorities regulating houses let in lodgings.

The Chairman said he was afraid there would not be time to discuss this matter, especially as he had a few words to say which he thought would be important. He would not detain the meeting by recapitulating what they had done, but he did not think they would have been found to have lost anything by the discretion which they had exercised, and in his opinion, the outcome of this Conference would, at least, be equal in value to any which had preceded it. What he wanted to say was, they ought to think about the future. They had had five Conferences, and the question was whether they should in future have a Conference annually or occasionally. He had been considering the question the last two days, and had come to this conclusion. During this five years, they had discussed from a sanitary, and, from a practical point of view, the sanitary legislation of the time; they had pointed out many blots, and he did not think it would be advisable to continue to meet annually, for the sake simply of proposing amendments of the clauses or sections of the Public Health Act, because they were not like a committee which sat from day to day, until it had exhausted every clause of the Act. By a natural process, their views were very much enlarged, as he had before explained. They had begun with the sewage of towns, and gradually, and almost imperceptibly found their views widening, until they at last had come to consider the whole scheme and system of local government, and the imperial supervision of the system. What was their position with reference to legislation at this moment? The Public Health Act, and others concerning the public health, no doubt wanted practical revision; but when that would take place, it was very difficult to say, because legislation, with the increasing complexity of the laws of society, became more difficult from year to year. But with regard to the question of practical amendments in the sanitary laws, his view would be, that the Conference should be called together again as soon as there was a prospect of legislation of that kind; that might be as soon as a Bill of that nature was laid on the table of the House; but without some basis of the kind to work upon, it would hardly be worth while to come together, and perhaps lessen the effect of what they had been doing by these

minuter criticisms from year to year. But there was the larger question of this reconstruction, so to say, of local government. Upon that they had made their remarks, and of which they must not lose sight; but with regard to that, also, he did not think they could serve their own purpose simply by repeating their blows from year to year. They had a new Government. The old Government came in with the intention of passing the County Boards Bill, and the present Government inherited that obligation from the antecedent Liberal Government six or seven years ago, and was bound to deal with the question as soon as some still more urgent questions were disposed of. His view was that, under these circumstances, the wisest course would be to leave it to the Council of the Society of Arts to consider when this Conference should be called together; with this intimation, that they ought to summon it again as soon as a Government measure of sufficient importance, either on details or on this larger subject of local government, was placed before the House of Commons and the country. Holding that opinion, he had put into form a resolution, which he begged to propose, "That the Society of Arts be requested to call this Conference together again when they deem it advisable, and specially to consider such advisability when a Government measure is brought in to create County Boards, or otherwise to deal with the question of local government."

Mr. Alcock seconded the motion. Whilst agreeing with the Chairman's views, he wished to add that the exhibition of sanitary appliances downstairs was rather cramped; and, although they might not hold the Conference annually, there were a large number of gentlemen connected with sanitary matters who came up to London every year on Parliamentary and other business, and it would be very well if they could have such an exhibition of sanitary appliances every year, in a place rather more commodious than the present. He had never visited one of these exhibitions without learning something.

The Secretary said the only reason why the exhibition was put in that confined space was because it was utterly impossible to get any larger place near at hand.

Mr. Collins said there were two other institutions, having cognate objects, who watched over this matter, and they would be only too glad to call the attention of the Society of Arts whenever occasion required, and he had no doubt the Society of Arts would assist by summoning a similar Conference.

The resolution was then put and carried.

Lord Alfred Churchill moved that the best thanks of the meeting be accorded to the Right Hon. James Stansfeld, M.P., for so ably presiding over the Conference. They were singularly fortunate in having secured his services, for, having been President of the Local Government Board, there was no one more able, by his knowledge of the question, to take this subject in hand.

The resolution having been passed unanimously,

The Chairman said he was exceedingly obliged for the compliment. This was the fifth occasion on which he had presided, and he could not have done so without having benefited himself by that educational process. He was glad to find that he had occupied the chair at all to the satisfaction of the meeting, and although he did not propose these Conferences should be annual, he did not believe he had seen the last of them; and he could only say that, when the occasion came for the next Conference, if they desired his services, they would be entirely at their disposal.

On Monday, June 14th, a public meeting of the Sanitary Section was held in the Rooms of the Society, at 12 noon, Edwin Chadwick, C.B., Vice-President of the Society, in the chair, when the evidence on House Drainage in London given before the Committee of the Section by Messrs. W. Eassie, Rogers Field, and E. P. Griffith, was discussed. The report of the evidence and of the discussion will be published in the pamphlet containing the Report of the Conference on Public Health, which will be ready shortly,

GENERAL NOTES.

Melbourne Exhibition.—On the recommendation of the Executive Committee of the Royal Commission, the President, H.R.H. the Prince of Wales, has been pleased to appoint Colonel Sir Herbert Sandford, R.A., to be the official representative of the Royal Commission at the Melbourne Exhibition, which opens on the 1st of October next.

New use for the Telephone.—To avoid the evil of having to cut and splice a telegraph cable unnecessarily, as when several lie close together and one only is faulty, it is now suggested to employ the telephone on an auxiliary parallel wire, in which the induction may be sufficiently strong to enable the electricians in charge to read the signals which may be sent into the cable, and so identify it.

Population of England and Wales.—A paper "On the Increase of Population in England and Wales," was read by Mr. R. Price Williams on the 15th ult., before the Statistical Society, in which he pointed out that the total increase of the population of England and Wales during the whole of the last century, was only 3,417,536, the average decennial rate of increase being 5 per cent., whereas during the present century, up to 1871, there was an increase of nearly 14 millions, the average decennial rate of increase being over 14 per cent. The rate of increase in the decade 1811-21, was the maximum attained in this century, viz., 18 per cent., as from that period down to the census of 1861, the rate of increase of the population had continuously diminished. He observed that a great increase of the population took place at the time when steam power began to be used for manufacturing purposes, and while the towns increased, the rural districts were found to diminish. Mr. Williams estimates that the population of England and Wales, by the census of 1881, will be 25,735,900. In the case of the population of London, the decrements were very slight indeed, showing that it had not reached that declining stage in the rate of its increase long since arrived at in the case of Liverpool, Manchester, and many other large towns. The population of London had increased from 958,863 in 1801, to 3,251,913 in 1871. He did not think there was sufficient data for estimating the future increase of the population of London for any lengthened period, and he regarded as unreliable the enormous estimates which had recently appeared in connection with the question of the metropolis, where the population in the course of the next century was estimated at over 17 millions.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

MEMBERS' SUBSCRIPTIONS.

The Midsummer subscriptions are now due. Cheques or Post-office orders for the above should be made payable to H. T. Wood, or order, crossed "Coutts and Co."

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FRIDAY, JULY 16, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EXAMINATIONS, 1880.

The list of successful Candidates in the Examinations for the present year has been printed, and is forwarded to the Institutions in Union with the present number of the *Journal*. Copies will also be sent to the various Local Boards for the successful candidates.

NATIONAL INSURANCE.

A Lecture on the subject of "National Insurance" was delivered before the Society, by the Rev. W. L. Blackley, M.A., on Wednesday last, 14th inst., at 3 p.m., the Earl of Shaftesbury, K.G., in the chair. A report of the Lecture and discussion will be printed in the next number of the *Journal*.

CENSUS OF 1881.

The following memorial has been sent by the Council to the President of the Local Government Board:—

TO THE RIGHT HONOURABLE J. D. DODSON, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

The Memorial of the Council of the Society of for the Encouragement of Arts, Manufactures, and Commerce.

RESPECTFULLY SHEWETH,—

That the Council are of opinion that the results of the Census, which will be held in 1881, might be published after a much shorter interval than is usually the case.

The Council would respectfully suggest that the duty of calculating the results, and preparing the returns upon them, might be devolved upon the local authorities, such as Superintendent Registrars, instead of upon the central office.

The Council believe that, by this measure—a measure which they understand is already employed in some foreign countries—much greater speed in publishing the results would be obtained.

The Council feel strongly that the delay, which, in some cases, amounts to three years, before the various statistics are published, greatly diminishes the value of such statistics, especially when it is remembered that, during this long interval, changes have taken place which, in many instances, render the statistics themselves entirely valueless for many purposes.

And your memorialists will ever pray, &c.

Signed on behalf of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, this fourteenth day of July, 1880.

FREDERICK J. BRAMWELL, Chairman of the Council.
H. TRUEMAN WOOD, Secretary.

The following address has been received by the Council from EDWIN CHADWICK, C.B., Vice-President of the Society:—

To the Council of the Society of Arts.

MY LORDS AND GENTLEMEN,

I have felt myself obliged, at much inconvenience, to comply with the requests made to me to enter into the subject of census enumerations of the population, and to state my experiences and observations in relation to them.

I presume that you will come to the conclusion that for good public administration, local as well as central, good public account-keeping is needed, as for private account-keeping, and for the progress of arts, manufactures, and commerce, there are required periodical "stock-takings," or accounts of the productive and non-productive forces to be dealt with. Accordingly, the census enumerations are to be regarded as stock-takings, in which, as experience shows, important amendments, to be hereinafter specified, are needed.

Basis of Census taking in Conditions of Local Administration.

At the periods of the first census enumerations in 1801, 1811, 1821, and 1830, the only general local administrative unit to be dealt with in England and Wales was the parish; and the chief administrator of that unit was, in general, the unpaid overseer, and that overseer was usually, in the rural districts, a farmer, and in the larger proportion of urban districts a small shopkeeper. Their own account keeping, when they did keep accounts, was usually of a very low order. It was found, under the Poor-law Commission of Inquiry, that a larger proportion of the farmer overseers then might be supposed to keep no accounts of their own whatsoever. When any returns or accounts were required, the parish schoolmaster was called in. In many parishes there were actually no account-books kept. We had brought to us, as the accounts, in one instance a pair of the overseer's (the farmer's) old boots; in one boot he put all the bills, and, in the other boot, all the receipts he got; and the contents of these boots constituted the parish accounts. In such common conditions of the then general local administrative unit, the first census enumerations were taken. They were obtained by Mr. Rickman, the Clerk Assistant to the House of Commons, with the authority of the House. He was obliged to invoke the assistance of all the parish clergy in getting out the enumerations of the particulars required, and mainly with their aid, the enumerations were obtained locally, and passably well; considering the conditions. But the enumerations were sent up to the central office in London, where they were summarised under Mr. Rickman's supervision, by an organised body of clerks. And this work of sum-

marising up to the last census has been continued to be centralised in London, there to be worked out by about a hundred clerks, who are occupied nearly three years in the completion of the work, at grievous expense of its accuracy, most of it, beyond the mere enumeration of the population, being in great part practically worthless. And this has been continued, notwithstanding the constitution of a new local administrative unit (the Union), competent to collect local information better, and also to act upon that information within itself, for the advantage of those whose affairs are administered by that unit, and for the exercise of new functions required in their behalf.

New Conditions of Literate Local Administration and Accountability.

To stay the enormous waste and malversation of the unpaid—and commonly illiterate—parish officers, the first thing proposed to be done, under a new system, was to impose a system of accountability on them, and to this end the first measure proposed was to appoint a large system of audit of public accounts by public auditors, at an expense of upwards of half a million per annum; and this measure was supported, at first, by Mr. Senior, as it was held that no reform could be effected until proper uniform and reliable accounts could be established. But my colleagues of the Poor-law Commission of Inquiry unanimously agreed with me that it would be futile to attempt to enforce account-keeping —still less, statistical returns—upon uneducated parish officers; and that, to obtain these and other large objects of local administration, we must get everywhere an enlarged administrative area—an area sufficiently large to maintain competent paid clerks and other paid administrative officers. Hence, in fact, chiefly for this object, the adoption of the new administrative unit, "the Union," which gained for the first time a properly qualified clerk, and other locally trained officers, and a systematised set of accounts, including provision for statistical returns, in keeping which they were exercised and checked by professional auditors. I got provision made for the registration of the causes as well as the fact of death, and the books ordered to be kept by the Union Medical Officers were provided with entries for data for statistical returns of sickness as well of deaths. For the administrative areas of 16,000 parishes, there were thenceforth substituted 620 Unions, and as many superintendent registrars, each, usually, with a private clerk; and, besides these, there are 270 schoolmasters, 1,600 collectors of poor's rates, 1,300 relieving officers, and 3,300 qualified medical officers, out of a total number of 18,000 paid officers acting in substitution of the 16,000 unpaid parish officers. I take occasion to mention, by the way, that all the Union-paid services were denounced at the time as extravagances. They have now been proved, however halting the administration may yet be, to have been the means of great economies. At present, to the extent of fully one-third of the previous average expenditure out of the rates concurrently, with advances of wages and rents, and, I believe, with the possibility of considerable further improvement. But, in respect to the census, I cannot stay to account for the fact—how it has happened that the practice of centralising the work of summarising the census returns, commenced originally of necessity in the period of what may be called illiterate local service, has been allowed to be continued during the succeeding period of literate and competent local service now existing. But I venture to say that, by the 600 superintendent registrars, with their clerks, and the assistance they may obtain, by payment as night work, from the men of the Union establishments, including the registrars themselves, the returns may be better summarised than they have been by the hundred clerks working at the central office, and completed in three months, instead of in three years. Surely, the pay of any one clerk, working for 36 months at the central office, may be applied to paying 36 clerks working one month at piecework in the locality, where it would be done better, as there are immediate means there of local information which are not possessed at the central office.

Actual Practice of Local Summarising.

In consequence, in great part, of the defects of the previous census, it has been necessary, in the Education Department, to take continued census enumerations of the great mass of the juvenile population by house-to-house visitations. The London School Board has a special statistical department, under the direction of an able statistical officer, to direct house-to-house inquiries and enumerations. The chief department at the Home-office, for the regulation of the labour of young children, has a constant house-to-house inquiry and enumeration of the children under the protected ages going on in the metropolis, and in the more densely populated districts; and in these several instances the local enumerations are all summarised locally, and, I am assured, summarised satisfactorily. The Statistical Department of the Board of Trade, under the able direction of Mr. Giffen, beside returns of the shipping and emigrants, has the annual agricultural returns of the farms and the acreage occupied by forty-seven millions of cattle, all of which are enumerated and summarised locally and satisfactorily, and got out in three months. If these enumerations were summarised centrally in the metropolis, the expense of time would be inordinate, and the objects of the statistics largely frustrated. In France, the population enumerations are summarised by the secretaries of the *mairies;* and I will show why the like course should be adopted here, and why the returns should be made more carefully and also extended, and the officers exercised in making them for the improvement of the local administration.

Of Need of Improvements, Specially for Sanitation.

Reserving for the present the statement of the additions to the returns required for the progress of arts, manufactures, and commerce, I beg to submit those required for sanitation, and also for insurances against excessive sickness and mortality. For these it is requisite that the enumeration of the chief classes of the population should be taken as closely, particularly, and accurately as possible, not only as to places, but as to occupations, that the experiences as to sickness and death incident to those persons and places may be compared with the present numbers of

living persons of the same occupations, and the same ages, and the same places, for the formation of safe insurance tables. Between the wage classes in one sort of manufacture in a rural district, with comparatively good cottages, and the wage classes of the same occupation living in a crowded urban district, and in worse sanitary condition, I have found differences in health of from one-fourth to one-third. The eyes of journeymen tailors working in the crowded shops of towns are stated to last only twenty years, whilst the eyes of tailors working in small shops in the rural districts last thirty years. Wide averages between such conditions are evidently misleading in the way of excess or deficiency for the purpose of tables of insurance or allowances in cases of disability. For a presidential address at the Sanitary Congress, held at Stafford, I obtained, not from the registration of the locality, but from the Registrar-General's office in London, the returns of the chief causes of deaths which had occurred in one year, in the chief wage classes in the county, which yielded very important indications for accurate conclusions. I should have got out the ages of the living operatives of these classes, amongst whom the deaths occurred, but they were not to be obtained in the locality. They were not known as they should be by the officers of health; and as enumerated nine years before, in the census returns, they would have been inexact to an extent that would have rendered them widely misleading. Changes in numbers and in localities of employment are now taking place in the rural districts, at accelerated rates, which it will be found of importance to note. Besides, the changes by migration, from one district to another, there are large changes going on by emigration. Between the time of the last census enumeration, and the time of the publication of the results, an emigration of nearly three-quarters of a million would have occurred, and at the conclusion of the decade of nearly two millions.

Considerable extensions of the headings of the census, and closer local summaries are needed for the aid and direction of the special service of Officers of Health. Thus the death-rates in particular localities, sub-districts, or streets of urban unions, are known to be excessively heavy. But the pressure of the lethal causes upon those localities cannot be determined even approximately, without some knowledge of the population within them; neither can the results of the expenditure on works, such as drainage works, be ascertained, except most vaguely and imperfectly, without a knowledge of the numbers living there. In one district in London, the sewers of several miles of street have been converted from sewers of deposit or self-extended cesspools, giving off noxious emanations into all the adjoining houses, into self-cleansing channels. But there being no summaries taken of the numbers of inhabitants there, the results of the alterations which were expected to be most important could not be ascertained. Dr. Hardwicke, the Coroner for Middlesex, representing the difficulties he was under, as Medical Officer of Health, for the great parish of Paddington, says:—

"It is to be regretted that returns of the decennial census when published will not give more precise information of streets, or groups of streets, or certain well-defined districts of large towns throughout the kingdom. A correct official return as to the density of population, the housing of people in *certain streets*, their ages, and occupations are all very essential data for every local officer of health, enabling him for the efficient discharge of his duties to compare the prevalence of disease and death in different places, and under various social conditions. I have endeavoured to supply this desideratum, by ascertaining the population of *all* the streets and places in this parish for future reference; and I have studied the composition of *certain streets* in particular, where the information is likely to be utilised for future sanitary work.

"The census returns in the present form apply only to registration districts, sub-districts, or ecclesiastical districts, and where a parish like Paddington is large, but still forming only a part of another district, viz., Kensington, the information is too vague, and must be in a separate form for special use.

"The different ways in which the metropolis has become divided for various purposes are such as tend to complicate the working out of statistical results. The *registration districts*, or a sub-district, taken as the unit or basis having well-known population, births, deaths, &c., *are scarcely ever in uniformity with districts defined for other purposes.*

"The borough boundary, for example, does not correspond with a School Board district; the Post-office and police have districts at variance; the parish, with its division into wards, under the Metropolis Local Management Act, does not correspond with either of the above, nor with the sub-registration districts, having known populations. Ecclesiastical districts appear to be best defined, and are selected for some reason for census districts.

"The Poor-law medical districts again, and the vaccination districts, also differ, so that it becomes difficult to compare one set of facts with another.

"The births and deaths, the number of houses and people, the number of males and females at given ages, or of any particular trade, the number of paupers, prisoners, lunatics, sick in hospitals in *any one or more of these districts ought to be more readily accessible to the public authorities*, and capable at any time of being utilised for statistical information when discussing questions bearing upon the local taxation, the water supply, the gas, or other purposes."

He showed that whilst in one part of his district, the most well-to-do there, were in the largest houses, about nine persons to each house; in another part there were smaller houses with one family in each room, and 14 to 24 in each small house. He says, "Some streets have a very high death-rate, as high as even 40, while other streets are as low as 7·5."

Error Latent in Generalities.

In sanitary science the errors in generalities are the most fatally disastrous, because, by obscuring and shielding the bad, they mislead efforts to improve. It is the particular streets, or blocks of buildings, with a double or threefold mortality—the fever nests—which require to be discriminated and closely examined. I have got examinations made of some of them as to their cost to the rates in pauperism and in crime, as well as in sickness, and it was evident that when all the costs were taken into account, it would be remunerative to the public to pay for their removal. It is important to have distinguished those streets where a single family occupies only one room, as also those rural districts where the population have only single-roomed tenements, or mud hovels. I append an example

got out from the census for Ireland, of the train of moral consequences, that are found to be attendant on such conditions. Such particulars serve to indicate the objective points of service, and to economise effort. In the Indian sanitary service it has been found the best to deal with particular cases indicated by detailed statistics rather than to base direct action upon wide averages and general principles to which the local authorities have not been accustomed to consider or apply. The dealing with one particular case gives a *point d'appui* for the next, and so on. By this course, the death-rates in particular buildings have been got at and reduced in India, which could not have been done from wide general averages.

Mr. Taylor, the Medical Officer of Liverpool, in a note to me, observes that "week by week returns are published of the rate of mortality in the different cities and towns, the population being estimated on the rate of increase between 1861 and 1871. This may be correct in the aggregate; but when each town is taken repeatedly it is far from the fact, and it has always been so in Liverpool. It is nothing more than a rough guess." Heavy epidemic visitations on the poorest districts are presented as inconsiderable variations of mortality when spread over large populations.

Mr. Welton, who is known to statisticians by his able papers on population questions, expresses his entire concurrence in the objections made to the mode in which the returns are now got out; and the belief "that local work might be relied upon with great advantage for the early and efficient tabulation of census results, and in deploring the manner in which, by delays in their publication, these results are allowed to become obsolete before they are available." He thinks 'the condensed tablets of occupations in registration districts published in the 1871 census volumes absolutely worthless." I have also found them so.

Examples of Local Changes going on in Populations, and Inaccuracies produced by Delays in getting out Census Returns.

However complete the house-to-house enumerations, and however complete the summaries may be made, in the central department they are rendered seriously inexact—and, indeed, to a great extent, worthless—by the great length of time occupied in getting them out, *i.e.*, two and three years. People are unaware of the extent of change always going on in industrial communities. In the City of London, the change of firms and occupations, according to a highly competent electoral agent, who would be trusted by all parties, is no less than 24 per cent. annually; thus, from the time of taking the census enumeration of the occupations to the time of its publication, there would be a change of upwards of 70 per cent. So great has been the change there that, I believe, there is not now a single resident Alderman, or past or present Mayor; all have quitted the area of their jurisdictions and service for the suburbs. The like changes are going on in Manchester, and, I believe, in other cities; much under the impulse, of seeking relief from the unsanitary conditions of the urban unsanitary administrations. Mr. Kelly informs me that the changes in the suburbs, in houses of upwards of fifty pounds per annum of rental, amount to twenty per cent. per annum. In the central districts, he finds the changes in the trades amount to about ten per cent. In the counties he has to make about the same extent of change required for his directories. All the names in his great but accurate London Directory, upwards of 200,000 annually, are collected in three months by forty men. The changes of residence amongst the workpeople are even greater, of which I append examples, which were obtained thirty years ago, but will, I expect, be exceeded at the present time—the changes of residence being governed chiefly by changes of manufactories, and of demands for labour; added to these, however, were the changes arising from emigration, which, among us, diminish largely the exactitude of a decennial census. Mr. Welton have shown that the losses of population by emigration have been greater in several counties than the losses by deaths.

The deficiencies of the knowledge of which the local authorities should possess for their administration is deplorable. To take the example of the foremost municipality in the Empire, the Corporation of the City of London—at present the fortieth part in number of the metropolis—it will know the numbers of its population as ascertained at the last census ten years ago. But it does not know its increments or decrements since then, so as to appreciate the influence of past legislation or administration. It has not known the numbers of the chief classes of society within the City, nor the increments or the decrements peculiar to each, nor the health and strength, nor the ages of the living, or the sickness and death-rates, nor the amount of destitution belonging to such class, nor the demands from it for relief from the rates, or from its charitable endowments. The number of the living of each occupation was enumerated in the census, but has not been distributed to the municipality to which they belong. It could not know, or at least until the recent school census, it could not know the numbers and the ages of the children of each class, or of the provision for their education, or for their physical or mental training, what becomes of them, or their increments or decrements, or the precise demands in respect to them, for guiding the application of its past educational endowments. That topic in the City is, indeed, the subject of a special investigation, by a Commission of Inquiry there, whose work, I expect, will be impeded by the absence of information from any detailed local census.

A Lord Mayor may have some notion of the fragment of the City—the ward which he represents as an Alderman, but it would astonish foreigners if they were made aware of the very inexact and vague knowledge he must have of the chief elements, the number and condition of the population over whose administrative affairs he presides, but amongst whom, as a rule, he no longer lives when out of office. And I expect it will be found much the same in respect to the municipal governments of Manchester, Liverpool, and other large provincial cities.

Deficiencies of the New Administrative Unit, the Union in Account-keeping and Stock-taking.

Even yet, there is serious deficiency of informa-

tion pervading even the new unit of local administration overlapping the municipality—the Union, with its new functions, sanitary and educational, and others continually added to it, requiring systematised information for their safe, efficient, and economical exercise. Soon after the institution of the Unions, they were provided with the best systematised accounts of money received and expended, and audits were regularly held by special auditors, to insure their being correctly kept. But systematised provision has yet to be made of comparative information for their guidance to show clearly how, and upon what conditions, the moneys entrusted to them may be economically andefficiently applied. To this end the information specified, as obtainable in good statistical accounts, would be largely contributory. Such information would inform them, not only of their positive, but of their relative, positions in each branch of administration, of which they usually know nothing. In a great number of Unions, their administration of money for the relief of destitution is deemed passably and positively good, whilst by reference to other actual standards, what may be shown to be perniciously in excess by one-half, or, amounting in the aggregate, to between three or four millions per annum. In sanitary administration, the condition of a place, as a result of a heavy expenditure, is made out to be good by reference to other places which are worse. Thus, London—where upwards of seventeen thousand persons (according to a low standard) fall victims to clearly preventable diseases—is called "the healthiest capital in the world," as a reason for an excessive unproductive expenditure, because the sanitary conditions of other capitals are worse, and their death-rates even heavier.

Conclusion as to the Localisation of Summaries of Census Enumerations.

On such experiences as those cited, as to the success, under good organisation, of local summarising, in speed and efficiency, it may be confidently submitted that the employment of some hundreds of clerks for three years at the central department, to complete the work of summarising the local enumerations under all their heads, may now be advantageously dispensed with; and that the work may now properly be charged on the new local administrative unit, the Union, or on its chief officer, the clerk and superintendent registrar (of whom there are 627); charging upon him, with his 89 assistants, the responsibility of accomplishing the work in a given time, and at a fixed charge, with such assistance as he may get from what may be called his staff of officers, working extra time for the occasion, at night work with extra pay. From those out of whom the clerks, as superintendent registrars, make selections for their service, efficient aid may doubtless be obtained. There are, besides, 250 Union school teachers, 1,600 rate collectors, and 1,300 relieving officers. From some 3,300 medical officers of health, information and aid may be expected on the points bearing on sanitation. The public services of all these officers are under the control of the Local Government Board. From some 29 of them, the mean staff of each Union, it is to be expected there would be little difficulty for the superintendent registrar to get the competent aid he would require. Exercised as most o that staff is in account keeping on system and with the check of an audit, as also in summarising with speed electoral returns under numerous headings, it may be assumed that they are of equal, not to say of superior, competency to the previously unpractised clerks collected hitherto under the central department. The pay of one such central clerk, hitherto occupied during three years or thirty-six months, may surely be made to suffice for thirty-six clerks, or officers acting as clerks in the locality, for one month—a time, as I am informed, sufficient to do the summarising work for Manchester, for example. The clerk acting in the locality may have immediate and convenient local information for his guidance, which the clerk in the centre might overlook, or only get by correspondence. Much of the local work on similar occasions, hitherto done with imperfect means and instructions, and with little responsibility, will have been done perfunctorily. But there has since then been much improved local practice, and it should be extended on the next occasion. I do not see why the service of the inspectors of the Local Government Board may not be applied for the occasion, for the distribution of instructions and in preliminary conferences, for aid to the execution of the measure. As to the central authority, the more it is considered, the better it will be found for the service of the local authorities to be under the control of the Local Government Board, and to be carried out by the officers of that Board. It may be submitted that the Registrar-General, who has no co-equal local powers, might well be relieved from the responsibility of carrying the measure into effect, and that it should be charged instead exclusively upon the Local Government Board itself.

Increasing Demand for more frequent Census Enumeration.—Annual Census Returns eventually required.

I beg, finally, to observe, that the great inconvenience of the decennial census is becoming more and more felt on the Continent, and applications are consequently being made to have the enumerations made quinquennially. Advances are, indeed, being made upon this, and calls made for triennial censuses. I have expressed a confident opinion, that a census enumeration ought to be got out annually, and might be got out at an inconsiderable expense beyond the decennial census. The basis of such a work might be got out in the first instance, by a complete registration of the inmates of every house, their ages, occupation, and conditions. The rate-collector, who visits every house annually, would leave with the rate or tax schedule to be filled up, also a census slip, on which he would see noted the differences in the increase or decrease of the number in the house as registered the year before. Annual census enumerations of parts of the population are now in progress. There is now an annual census of what is called the upper ten thousand, their ages, their marriages, and positions; there are, also, the annual Court Guides; and there is the great annual census of the postal directory of London, including, not only the Court Guide, the names of all the members of the professions, but all the trades and manufactures. Similar annual censuses or direc-

tories are in progress in our chief provincial cities.

An annual census enumeration being now found necessary for educational purpose, and for the regulation of the labour of young persons in factories, I expect that the enumeration of the adult population would go far to make up an annual census of the differences between year and year, that would probably not materially exceed the yearly proportion of the expenses of the decennial census. At the Statistical Congress at the Hague I had, as regards the chief centres of industry, the support of Professor Engel, the head of the Statistical Department of Prussia, who believes it to be practical, and has endeavoured to get one carried out, but he found the project was very unpopular in Germany; probably under the feeling that it was not intended for the advantage of the local authority, but that fuller accounts of the productive forces of the Empire were sought, for military ends, and for the augmentation of the central authority. Here the measure, as proposed, would be eminently a measure of decentralisation, and one for local consolidation, and would soon be understood as a means for a better insight into forty millions of annual local taxation, and the better guidance of its expenditure, and for the promotion of the health and strength of the population. I hope that intelligence and spirit enough may be found in some city, to set the example of a complete census for itself.

From the facts stated, it will be seen that the attainment of the object of the resolutions adopted by the Council, on which members of the Sanitary Institute are also agreed, namely, the completion and issue of an improved census in three months, as in continental States, instead of in three years as here, is the main end to be immediately sought. And this may be accomplished by leaving to the central department only the work of summarising the general heads of the local summaries, and by leaving to the local authorities the particular summaries required for their local use, such as of the population of streets in urban districts, and of villages in the rural districts, which are required for the local sanitary service. By this change, an advance may be made in the local, and in the general, public service, to the level of the complete account-keeping, and stock-taking, in the best private practice in Arts, Manufactures, and Commerce, thus at once promoting the health and strength of our population, as well as to the efficiency and economy of local administration.

Edwin Chadwick.

Appendix No. 1.—*Statistical Illustration of the Sequence of Moral as well as Physical Consequences following Mud-hovelled Populations.*

The dependency of the duration of life upon the physical condition of the population, and the connection of the several classes of moral and economical facts with the proportionate mortality, may be thus exemplified.

Taking the four counties in Ireland in which the proportion of mud hovels, with only one room, is the greatest, and the four counties in which the proportions of such tenaments are the least; having obtained these proportions, I directed other returns to be obtained in their order, and confidently anticipated the general results following from the facts indicative of the physical condition of the population.

	The four counties where the average proportion of mud-hovels as habitations is the lowest.	The four counties were the average proportion of mud-hovels as habitations is the highest.
Proportion per cent. of families occupying habitations which are mud cabins, having only one room	29·	61·
Proportion of deaths from epidemic disease to every 10,000 of the population	35·5	47·8
Average age of all who have died during the ten years ended 6th June, 1841	33·4	26·8
Proportion of births to the population	33·4	29·9
Increase per cent. of the population since 1831	5·	8·7
Per cent. of the population 15 years and under	38·8	41·9
Above 50 years	11·6	9·5
Proportion per cent. of male and female population 17 years and upwards—Unmarried	43·25	39·
,, ,, ,, Married	47·75	53·
Per cent. of the population 5 years old and upwards, who can neither read nor write	42·8	69·7
Proportion of crimes of violence or passion to each 10,000, on an average of 8 years, to 1842	32·	72·
Rapes and assaults with intent	17·	44·

Appendix No. 2.—*Statistical Exposition of the Changes in the Residences of the Wage Classes of the Population.*

In Westminster.

Length of Time which the principal Members of 5,366 Families of the Working Classes visited state that they resided in their Dwellings.

Period.	St. Margaret's.	St. John's.	Total.	Proportion.
From Month. 1 to Months. 6 ..	604	1,230	1,834	$\frac{1}{3}$
,, 6 to Year. 1 ..	205	316	521	$\frac{1}{10}$
,, 1 to Year. 3 ..	360	676	1,036	$\frac{1}{5}$
,, 3 to 6 ..	602	389	991	$\frac{1}{5}$
,, 6 to 9 ..	126	97	223	$\frac{1}{24}$
,, 9 to 12 ..	60	48	108	$\frac{1}{50}$
,, 12 to 15 ..	9	17	26	$\frac{1}{206}$
,, 15 to 20 ..	4	18	22	$\frac{1}{244}$
,, 20 to 40 ..	2	11	13	$\frac{1}{413}$
Not ascertained....	138	454	592	$\frac{1}{9}$
	2,110	3,256	5,366	
	Y. M.	Y. M.	Y. M.	
Average period of residence in each parish and in the total.....	2 10	2 0	2 4	

York.

Table showing the time 2,015 Families, principally of the Labouring Classes, residing in York, lived in their present Residence.

Period.	Total numbers.	Proportion.
Under 1 year.....	466	$\frac{1}{4}$
From 1 to 2 years	217	$\frac{1}{9}$
,, 2 to 5 ,, ...	458	$\frac{1}{4}$
,, 5 to 10 ,, ...	394	$\frac{1}{5}$
,, 10 to 15 ,, ...	179	$\frac{1}{11}$
,, 15 to 20 ,, ...	75	$\frac{1}{27}$
,, 20 and above	155	$\frac{1}{13}$
Not stated	71	$\frac{1}{28}$

INDIAN SECTION.

Friday, May 14, 1880; Prof. Robert K. Douglas in the Chair.

The Chairman, in introducing Col. Yule, said he much regretted that, owing to a sudden attack of illness, M. Terrien de la Couperie had been unable to prepare the paper that evening. He much regretted this, as it was a paper of surpassing interest, and he believed M. Terrien would have shown that, by a patient study of the history and languages of many of the peoples of ancient Asia, he had been able to solve the historic enigma embodied in the isolation of China, and the uniqueness of its language, and that the final result of those researches had been to prove that there exists a marked and strong affinity between the languages, traditions, and arts of ancient China and of Babylonia. He hoped, however, that this unfortunate illness would not prevent their having the paper at some future time. He had only now to announce that Col. Yule had, with very great kindness, consented to read a paper on a subject with which his name was indelibly associated, the travels of Marco Polo.

Colonel Yule wished the audience kindly to understand that he came forward on this occasion, not because he had anything of novelty or importance to lay before the Society, but simply on a sudden emergency, when it was much too late to give notice of the unavoidable delay in the completion of his friend M. Terrien's paper, to fill the gap by reading a lecture, connected at least with China, which he had prepared and delivered some years ago in another place. The lecture, which occupied about an hour in delivery, is not, under these circumstances, a paper suited for publication by the Society; indeed, it would be contrary to the wish of the lecturer that it should be published. What follows is, therefore, only a brief abstract.

The lecturer began by sketching the circumstances which, in the 12th century, fixed the attention of Europe upon Asia, through the propagation of the stories of Prester John, and again in the succeeding century, through the conquests of Chinghiz Khan—attention which became converted into dismay when the successor of Chinghiz advanced almost into the heart of Europe. The spread of the Mongol power opened Asia to European travellers and traders as it has never been opened again. Among the first of those traders were Nicolo and Maffeo Polo, of Venice. The circumstances which, step by step, conducted them to the Court of the great Khan, Kublai, grandson of Chinghiz, on the northern frontier of China, were stated, as of the mission on which he sent them back to Europe, and their return, after a stay of three years there, to the far East, with Marco, the young son of Nicolo. Their long and devious journey across the longitude of Asia was traced; and the history of Marco, as an officer in the employment of the great Khan, and as a traveller over a great part of his empire, whilst executing the commissions of that sovereign. Colonel Yule then related the romantic circumstances under which the party were at last enabled to leave China by sea—a voyage which introduced to Europe the knowledge of the great islands of the Indian Archipelago, of Ceylon, and of Southern India. And he read from Ramusio the quaint account of their arrival at Venice, after 26 years of absence; and the way in which the travellers prevailed on their fellow-citizens at last to recognise them as the Polos who had been so long counted among the dead. The lecturer then related the circumstances which caused Marco Polo to go to sea in defence of his native republic against Genoa, leading to his capture and imprisonment in that place, and to the dictation of his story then, apparently for the first time, to a fellow-prisoner.

Some remarks followed upon the book, and the character of the man as deduced from it, on its true value and bearing on the history of geographical knowledge, and especially on the ideas of Columbus.

DISCUSSION.

The Chairman, in inviting discussion, said a great deal they had heard must have been fresh even to those who knew well Col. Yule's edition of the great traveller's work. It was a history full of wonderful surprises and romance; the idea of this man, with no support but his own wit and courage, travelling across the whole length and breadth of Asia, meeting with kings and potentates, and taking high office in the kingdom of China, was very remarkable, especially when they considered how difficult it was, at the present day, to travel in any part of Central Asia, and even in China, without the help of passports and letters of recommendation. The rise of the Mongol Empire was also a subject for wonder, when they remembered that the founder of it had his birth in a small hut on the banks of the River Onon; that he inherited the command of only a small tribe of Mongols, and from that small beginning grew and grew until he was able to sweep with his armies over the whole of Asia, and a great part of Europe, so that, as had been said by Col. Yule elsewhere, a dog could not bark without Mongol leave from the western borders of Poland to the Yellow Sea; yet, at no very distant date, this enormous Empire, which had established itself over Asia with a hurricane-like force, dwindled away and disappeared, and the tribe which had risen to such sudden power retreated and contracted again, until it took up its former home on the banks of the Onon, where it remained at the present day more or less unknown, and comparatively powerless. Another very remarkable feature about the history of Marco Polo was the extreme accuracy of his observations. He appears to have taken no notes whatever during his travels or residence in China, and years afterwards, in his native country, he was able to dictate to an amanuensis the history of his travels so accurately, that travellers at the present day found almost every word he said capable of verification. Thus the tribe of the Golden Teeth, of which Col. Yule had spoken, was described by Chinese writers as existing in

the Province of Yunnan; and, again, another strange practice to which Col. Yule had alluded was still current amongst some tribes. He was happy to see a gentlemen present who had lately travelled across China, who would be no doubt able to confirm what he had said.

Mr. Pfoundes said there were one or two points on which it would be interesting to have an opinion from so great an authority as Colonel Yule. There was a question of the disputed origin of Genghis Khan, and he should like to say a word about the Zipango which Marco Polo spoke about. Marco Polo was responsible for a great deal, for it was he who really sent, during the 14th and 15th centuries, all those adventurers whose work culminated in the great discoveries in America, and subsequently of Australia, Australasia, and the Polynesian Islands. He might say also that it was his book which had sent him wandering all round the world for some 26 years. With regard to this question of Fuishan, the learned Chairman once told him he quite agreed with him that this Fuishan, which was supposed to be Mexico by some, was actually Japan; and so forcibly was he struck by that some years ago, that he called a collection of notes which he published about Japan a "Collection of Fuishan." He should like to have Col. Yule's opinion whether Fuishan or Fuiso was really Mexico. The second question was as to the origin of Genghis Khan. The Japanese claimed that he was a Japanese adventurer, who ran away from his brother, the great Yorimoto, at the end of the 12th century; and, in fact, after the disappearance of this wanderer until he returned, there was a period of exactly 30 years, in which he could have performed all those wonders which were attributed to him. It was quite possible he might have gone over the continent through the Corea with a small following of Japanese. Another point was, the question of the Zipango of Marco Polo, and whether it did not really refer to Japan. For some centuries Japan had been known under another name, and the Emperor of Chin a used to write to the Emperor of Japan "from the Sun of Heaven in the Land of the Setting Sun, to the Sun of Heaven in the Land of the Rising Sun." Previous to that, Japan was known by the name of "Wu-ti," and several other names, and it would be interesting to know if our name of Japan really came from the word Zipango. It was pretty clear to him that foreigners had lived in Japan before 1642, for he had discovered in Japanese annals that early in the 16th century foreigners visited the coast, and they were invariably called "black ships." The native craft on that coast were never painted black, but the foreign vessels coming there were. Previous to the year 1530, not only had foreign ships visited Japan, but in one case the captain had, in return for a quantity of provisions supplied to his sick sailors, given two pieces of firearms, as it was described. This was in 1529, and later on they actually gave a number of details with regard to other vessels, and attempted to render the foreign names of the captains in the Chinese character. On one occasion they gave the number of the crew of one vessel as 290 men. The great wall of China having been alluded to, he might mention that the Emperor who caused it to be built also attempted to exterminate all scholars, and at that time a great number of learned Chinese made their escape to Japan. He also sent a mission to Japan in search of the philosopher's stone and the elixir of life, but the astute envoy who went there, and who knew that his predecessors, who had returned unsuccessful, had had to commit suicide, managed to make friends with the Court of Japan, and remained there, where he founded a family which existed till the present time.

Captain Gill being called upon, said he came rather to listen than to speak, but he could not refrain saying a few words in favour of his old friend, Marco Polo, whose book had solaced many hours during his journey. If it were true that Marco Polo had sent many travellers journeying all over the world, it was none the less true that it was to Colonel Yule that many were indebted for the knowledge of Marco Polo, and for a right comprehension of the book which had been published, bearing his name. The previous versions, however good they had been, were incomprehensible to him until Colonel Yule brought his researches to bear upon them, and gave to the world those volumes now so well known, not only describing the travels of Marco Polo, but also forming a complete encyclopedia of useful information. Although he could not claim to have travelled over such vast areas, or to have explored so many unknown regions as Marco Polo, he had followed in his footsteps in China, and he must say that any one who had done that must have been struck with the extraordinary accuracy of his accounts, and the wonderful power of observation he possessed. He had followed him into Western China, into the province of Suchew, and there he found the capital of that province still a rich and noble city. Not only so, but he found many of the little details of daily life exactly as he described them. For instance, the bridges over the rivers almost always had a roof, and along the sides you still saw, as he described, hucksters sitting down selling their wares. Again, as you travelled westward, you came to a place called Vochan by Marco Polo, who mentioned how a great battle was fought there. He had often lingered over the description of that battle, for it was one of the most amusing he had ever read. In these last years, they found on that very site another battle had been fought, between the Mohammedan rebels and the Chinese. Vochan was now known as Yung Chan, and there the passage of the river was contested for many months between the rebels and the Chinese. Again, Marco Polo spoke of a country so unhealthy that no man might pass in the summer time, and he drew particular attention to this because he did not usually speak of the unhealthiness of the climate. There, again, the traveller's remarkable accuracy was illustrated, for long before he (Capt. Gill) reached this region he heard of it; and as he got nearer and nearer this low lying valley, the same stories were told in almost unvarying detail. When he reached it, he found there was a valley in which the inhabitants themselves were obliged to leave during the unhealthy season of the summer, and no stranger could stay there. Any stranger who ventured to sleep there, would be almost certain to have a violent fever by the morning, and would be forced to fly if strength remained to do so. It was remarkable to find that this country was described by Polo as being wild and hard of access, and no words could be found more fitting to describe it now. This was the country which lay between Burmah and China, and anybody who had travelled over the mountains and valleys which lay there, must feel how true were his words. This unhealthy valley, which lay in that country, was one of the most remarkable places in the world. There were other valleys on each side which did not share the fevers which existed there. At one time it was the custom of the Chinese to post sentries at each side of the bridge which crossed the river to prevent travellers coming down in the unhealthy time, and it was said that at that time a sort of red vapour hung over the valley. When he was there, it was a beautiful fine day, and as he looked down upon this valley from the hills and saw it all covered with beautiful crops, he could hardly imagine it could be the scene of such a deadly climate. He could not help thinking that Marco Polo must have been remarkably fond of good living, because he dwelt so much on good hotels and hostelries which he found in some of these countries; even now, travellers who went from China into the regions which bounded it, where civilisation was unknown, would quite appreciate the good hotels and hostelries which were to be found in China proper, of which Marco Polo spoke.

In many other respects, his other observations had been verified by subsequent travellers. For instance, he told a story of a tribe dwelling somewhere on the borders of China, who had an unpleasant habit of always killing rich or prosperous strangers who went there, because they had an idea that the riches, knowledge, and prosperity of the strangers would pass to those who killed them. Now, he (Capt. Gill) was meditating an excursion into some mountain region in that neighbourhood, when he was warned by French missionaries never to take any food offered him by the mountaineers, because they would be sure to poison him, believing that if they poisoned rich people their riches would pass to them. Again, Marco Polo spoke about the salt in the western provinces as being sometimes cast in a shape like a twopenny loaf. Now, it so happened that one day he (Capt. Gill) walked out in the street with a friend, early in the morning, as the people were coming into market, and there he saw cakes of salt in many different shapes, according to the different regions from which it came, and his friend said to him, "Here is salt just in the shape of a loaf," using without knowing it, the very words which Marco Polo had used himself. In every respect, therefore, one was struck with the wonderful accuracy of observation of the great Venetian; and he must say that he had been much indebted to Polo for whiling away many hours whilst on his journey, and equally so to Col. Yule, who had introduced the work to him.

Mr. Christian Mast begged to thank the lecturer for his most interesting paper, which he should take the opportunity of reading to the pupils in his school, and he suggested that it would be very useful if a cheap edition of Marco Polo's travels could be prepared as a reading-book for schools. He had never seen such a one in England, although, in Germany, Marco Polo was very popular amongst children.

Mr. Hale thought the suggestion just made was a very good one.

The Chairman proposed a vote of thanks to Col. Yule for the great kindness with which he had come forward to fill up the gap that evening.

Mr. Dipnall seconded the motion, which was carried unanimously.

Mons. Terrien de la Couperie's paper has been received since the meeting, and the following is a translation:—

CHINA AND THE CHINESE: THEIR EARLY HISTORY AND FUTURE PROSPECTS.

By A. Terrien de la Couperie.

In coming before you this evening, to discuss the Chinese and their history, both primitive and future, I should feel I was exceeding my powers, had I an audience less intelligent than the one whose kindly attention I now claim.

It is neither of philosophy nor of politics I have to speak, though the events now occurring in the far East are likely to have no small influence on the interests of Western Europe. When we speak of the Chinese, of their language, of their habits, of their necessities, we seldom remember that we are speaking of a third part of the whole human race. Attempts have been made to upset this statement; it has been argued that the approximate calculations on which it is based are erroneous; but, after all, we are forced to admit a total varying from 400 to 420 millions of human beings. This colossal agglomeration is cemented solely by traditions growing weaker every day. If in place of a fictitious army of 250,000 men, which is nothing more than a militia or a police, the nation was organised like the great military powers of Europe, its ruler would have under him an army of ten millions. The Chinese, too, has the qualities required for a good soldier, he is courageous, strong, sober, and patient; he respects constituted authority; he requires nothing but discipline and capable officers. I need not repeat, what must be well-known to those present, the early history of China, with the incessant struggles, successful and unsuccessful, against neighbouring races, from the time of the arrival of the Hundred Families on the banks of the Yellow and Blue Rivers, down to our own times; nor need I dwell on the struggles of the race against climate and other natural hardships —struggles which have produced a race such as it is to-day. These matters have been treated in a masterly way by that illustrious traveller and geographer, the Baron Richthofen, who has, unfortunately, not yet found an English translator. It would take me too far from my subject, also, if I were to remind you of the great, yet unexplained, laws which govern the great movements of the human race. The Italian writer, Ferrari, has shown that these laws may be observed acting as regularly in the history of Chinese growth and development as in the Western world, and that the moment has now arrived when we may expect a great change in the empire. It is not, as a great thinker has said, religion, or philosophy, or race, or climate, or social conditions, which affect most powerfully the history of the human race; it is instinct, the unconscious genius of the race.

My object is to show you, by the results of some recent investigations, that the ordinary opinion which would regard China as a world by itself—with a distinct language, and a peculiar way of writing which it has invented for itself—is incorrect, and is based on insufficient study.

One of the most serious obstacles which has hindered European scholars from becoming accurately acquainted with the position held by the Chinese people in relation to other nations, is the extraordinary aspect of the language, the extreme complications of its written vocabulary, accompanied by a not less remarkable poverty in the words as uttered. To a European, the Chinese language is one of the most difficult in the world. The general belief that the language is a rich one is founded on the fact that its characters amount to about 80,000 (of which nearly half will be found in the great dictionary of Kang-hi), each conception, or each idea, being expressed by a particular character. The difficulty, in this view, would only lie in the multiplicity of written signs; yet this mode of regarding the matter is not the correct one.

The number of characters that we meet with in Chinese books is limited enough; in fact, it may perhaps be estimated at about 8,000. But a large part of these characters have a plurality of significations, which depend upon their combination with other characters, upon the branch of science of which the work treats, as also upon the period when the same was written.

For instance, the character *shi* means "really;" yet, in botanical works, this same hieroglyphic denotes the "seed of plants." In order to understand Chinese books, a knowledge of characters taken singly will not suffice; their position must also be taken into consideration, as well as their combination with other characters.

In dictionaries, for instance, one finds *fú*, "to help, to assist," and *ma*, "a horse." But *fuma* does not, as might be thought, mean a "helping horse;" in Chinese historical books these two characters are always used to denote "the son-in-law of the Emperor." Thus Tamerlane is known in Chinese history as *Teimurk Fuma*.

Chinese literature is very rich in combinations of this kind, and in sentences composed of two or more characters; in most cases, their individual signification does not serve to show us the meaning of the whole. It is a vain task to search for these through dictionaries; the greater number of them, although often unknown to European students, have been handed down by tradition to the Chinese of to-day, with whom these expressions are become so familiar, that they have deemed it superfluous to put them in their dictionaries. A Chinese dictionary in a European language, with a complete collection of phrases, has long been a desideratum; that this is so, is partly due to the vastness of such an undertaking. The *Syllabic Dictionary*, published four years ago by the learned Dr. Wells Williams, has, in a measure, filled this gap; so, too, has the "Chinese-Russian Lexicon," which M. Wassilief, a scholar of great distinction, has just issued. There are two grave difficulties that translators from the Chinese text have to overcome. One of these is the possible confusion of Chinese signs used phonetically for the transcription of proper names, and apart from all signification, with the other characters which express the meaning of the sentence. All the characters taken by themselves have some meaning attached to them, and it is often difficult for a European scholar, unless he have the help of a native, to distinguish characters by which sounds only are represented from those which have to be translated.

Another difficulty for the European reader of Chinese texts is caused by the utter absence in Chinese of any system of punctuation like ours. There are certain characters which mark the close of sentences, but they are rarely employed, and, generally, a whole chapter is without sub-division of any kind, so that the reader has to settle the punctuation for himself as he goes on. And there is no need to search for examples in our own alphabetical languages to show that an error in punctuation may change the entire meaning of a sentence, or even of a whole chapter; and, therefore, it is wise, as much as possible, to consult Japanese editions, which do use punctuation.

It was not till after European scholars had studied this curious language for two centuries, that it was first shown (by the Rev. J. Edkins), in a remarkable paper published in China, how much help could be got by comparison of dialects, and by other means, in demonstrating the modifications through which Chinese words have passed. Before entering into this important question, permit me to quote two works to you, of vastly different sizes (folio and duodecimo), both published at nearly the same time, namely, more than a couple of centuries ago.

In 1667, there appeared at Amsterdam the voluminous folio by P. Kircher, on "China, as illustrated by its Monuments," published in Latin, of which a French version was shortly afterwards issued. The only important difference between the two editions was the addition of a Chinese-French vocabulary, the Chinese words being given without the characters, and with the Portuguese spelling adopted at Macao. This was, as I believe, the first one ever published; for that reason I have thought it of sufficient interest to mention it. The work by P. Kircher is not so wholly undeserving of attention as might be imagined from his questionable reputation. His descriptions of Chinese manners and customs are borrowed from the accounts given by the Jesuits, and are, so far, not without value. It is what he has himself added that calls for criticism, such as illustrations evidently taken from description, and not drawn on the spot. But the most singular chapter to examine is the one that treats of Chinese writing, since it is responsible for errors that have been repeated for many years as to the history of Chinese writing and the origin of the Chinese characters.

Calligraphy has always been held by the Chinese in high esteem; and their annals commemorate men who are famous for their skill with the hair-pencil. But apart from the characters in their regular shape, there are certain fanciful forms which the Chinese have always highly admired in proportion as the calligrapher's talent enabled him, without departing from the classic outline, to give to some, or even to every character the semblance of an ear of corn, a leaf, a bird, a dragon, a fish, a tortoise, or a star. The method of fantastic lettering, which we may often notice on shop-fronts in Europe, is something of the same kind. Now, the fourteen or fifteen series of characters, of which P. Kircher gives the figures, are only specimens of these fanciful eccentricities; yet he has put them forward, arranged according to the objects depicted, as if they formed so many categories of pictorial writing, which have become the origin of the modern characters. This error of the learned Jesuit, who was one of the notable men of his day, shows us how dangerous it is to touch upon such questions without the requisite knowledge.

Two years after the publication of Kircher's work, there appeared in this country a volume by John Webb, of Berkshire, putting forward a notion which has held its ground more or less to our own day. The author's theory is at once shown by the following title chosen for his learned little book:—"An Historical Essay on the Probability that the Language of the Empire of China is the Primitive Language." Nine years later, the book was re-issued with a new title-page; the text, however, remained unchanged.

In 1787, as though this name of Webb was to be identified with the study of Chinese, one Daniel Webb issued a little work, entitled "Some Reasons for thinking that the Greek Language was borrowed from the Chinese, in Notes on the Grammatica Sinica of M. Fourmont."

I do not think it is necessary to detain you by pointing out the fallacy of both these theories. There would be nothing to choose between them,

were it not that the multiplicity of uses to which Chinese words have been put, through their paucity, has been made an argument in speculations on the primitive monosylabism of speech, of which Chinese has been quoted as a crystallised example.

The serious enfeeblement of the Chinese phonetic system, the decayed state of the vocables, the small variety of sounds to which they have been reduced, in contrast to the vast number of the signs used to express them, with a ten-fold multiplication of meaning, all this has rendered it possible to find an apparent consonance with almost any monosyllable of another language. Such was the mistake of Klaproth, when he compiled the memoir, which he called "Hic et Ubique; Vestiges de la Langue Primitive retrouvée dans le Chinois;" and such also has been the mistake of many another mind nearer our own time. But the state of things is entirely different when you deal with Chinese vocables as they were before the Christian era, and when the subjects of comparison are vocables containing two consonants, in which there is much less chance of delusive coincidences.

The sources to which we may have recourse in tracing the phonetic variations through which the Chinese language has passed in the course of ages, are numerous, and of very different kinds. But they belong to a series of facts which it is a difficult and delicate task to establish, and which demands from the investigator both sober erudition and acumen, unless he would see the whole apparatus that he has erected with so much time and labour turned against himself and the result he aims at.

These facts come from different quarters, and may be thus summarised:—

1. The Tonic dictionaries of the Chinese.
2. The Buddhist transcripts of Sanskrit terms.
3. Modern Chinese dialects.
4. The more ancient extra-Chinese dialects and modes of pronunciation; such as the Japanese *Go-on* and *Kan-on;* the two Sino Corean dialects; the Anamite form of Chinese.
5. The phonetic symbols used since the 2nd century B.C., in newly formed characters.
6. Rhymes in the old poems.
7. The study of the writing called *Ku-wen*, anterior to the 9th century B.C.
8. The employment of certain characters in the classics and elsewhere, with a signification different from their idiographic value, a signification which through the changes of pronunciation they have not preserved.
9. The mute letters (excluding prefixes) and in general the spelling used in Tibetan.
10. The equivalent words in Taï (Siamese, &c.), Burmese, Annamite, and several other languages.
11. Equivalent words in the Uzal-Altaic languages.

It is indeed a great puzzle—the task of recovering the ancient pronunciation—but it is impossible for me to enter here upon the details obtained from the sources which I have just indicated, and through which we are enabled to recognise the great changes that have occurred in the words since the days of old. I will quote but one example. In the year A.D. 65, the Emperor Ming-Ti sent for Buddhist priests to teach the doctrines which have gathered round the legend of Sakyamuni. In the Chinese texts, the Sanskrit name of the chief of the two priests who arrived is transcribed in four characters, which to-day are pronounced as *Kia-ye-mo-tang*. Now, if we consult that Chinese dialect which has most preserved traces of the archaic phonetism, we find these same four words to be pronounced as *Ka dziep ma tang*, which is almost identical with the Sanskrit *Kaçyapay Matanga*.

The transcription of proper names, and of a certain number of the sacred words of Buddhist literature, form one of the safest methods of this kind of restoration. But even these cannot be used without discrimination, for the transcripts have been made during a space of more than 1,000 years, during which thousands of books were translated in different provinces, and, consequently, under the influence of different provincial dialects, as well as subject to the general modifications of language through that long space of years.

And I may say that if the study of these transcripts has not hitherto produced any sufficient result, it is because no proper account has been taken of these differences; they have, in fact, been regarded as mere irregularities, due, most frequently, to the deficiencies of the translator. I may cite an example from the great compilation which caused so many years of toil to the greatest translator from the Chinese yet known in Europe—I mean the lamented Stanislas Julien—the "Méthode de déchiffrer et transcrire les Noms Sanskrits qui se rencontrent dans les Livres Chinois, inventée et demontrée." In this compilation, which no one could have produced who did not possess the physical vigour of its author, examples are derived from every century and every locality without any suggestion of those causes of difference which we have indicated. And thus it is that the exceptions are more in number than the instances that follow the rules, and the student is candidly invited to choose that result which best suits his object.

The Chinese form of writing, as used in printed books, the *Kiai-shu* of the present day (allowing for certain improvements added under the Sung dynasty about the 10th century) dates from the 4th century of our era, but no further back. It is composed of 109 different elements or strokes, the position of which was an imitation of the more rounded and thicker writing, called *Li-shu*, modified by the rapidity of execution, which had become possible through the improvements in the apparatus of the scribe, viz., his paper and hair pencil. The *Li-shu* had been the official text since the days of the T'sin dynasty, at which time it was devised through the necessity for a uniform system throughout the empire. This, again, had been preceded by the *Siao-chuen*, a character composed of meagre and monotonous strokes such as were adapted to the materials then in use, viz., a bamboo written on with a *stylus*. This, again, was an official modification, originating in the same desire for uniformity, which had been attempted in the reign of the great Shi-Hoang of the T'sin. The *Siao-chuen* had been modified from the ancient mode of writing called *Ta-chuen*, in which great variations had developed themselves among the different States (independent, eventually, rather than feudatory) which had had once been subject to the ancient dominion of the Chæu; but the amount of modification had been made great, and

the attempt had failed in its aim. Now, from these successive official changes came a great number of alterations in the elements of the characters intended to make them answer more exactly to their signification as shaped by the ideas then dominant, and, by the systematic interpretation, more or less in vogue; the addition in compound characters of a considerable number of determinative ideographic elements without affecting the sound; all leaving their stamp on the composition of the characters in use. Now, it is this stamp which, for many a year—I must not say for centuries—has been a clog on the steps of European students in their efforts to investigate the true nature of Chinese writing.

The doctrines on the nature and formation of the symbols used in Chinese writing, as they have been hitherto accepted and taught, in accordance with the views of native scholars, rest, for the most part, on a very fragile foundation, and one need not fear to be accused of rashness in saying that they are destined to go through very profound modifications under the processes of European criticism.

The accepted interpretation of the famous formula, *Luh-shu*, which forms the basis of the system, is by the admission of the Chinese literati themselves a comparatively late one. We must not confound the explanation and commentaries upon commentaries, of which it has been the object, with the formula itself. The latter is already mentioned in the 11th century B.C., and I myself believe it to be much older than that, and I think I see in it, with the group of legendary circumstances which gather round the single word *Lok* (by terms indicating book, river, horse, or dragon), the extension of a tradition vastly more ancient, probably of foreign origin, and common to other nations of the highest antiquity. But full of interest as such an inquiry would be, this is not the place to enter on a question requiring so much detail.

The explanation of the *Luh-shu* is supplied to us only by the scholars and philosophers of the Han period, and it is not easy for us to judge to what extent they were the echo of older tradition. But in any case, if we examine the two oldest lists, that furnished by Pan-ku, the historian of the First Han, and that of Hü-shen, in the introduction to his famous dictionary, the Shwo-wen, and that of Ching-tong, the oldest commentator of the Chœu-li, we shall not find that their explanations, however they may be akin to one another, have that identity which we should expect if those explanations had before the age of these writers, attained to that degree of system and fixity which belongs to such an established doctrine as tradition ascribes to them. Their differences, in fact, have a real importance, for they mark an epoch during which the sages of China occupied themselves with the interpretation of the *Luh-shu*, without being able to agree upon it, and thus we find a justification for the view current in later centuries, and expressed in the words that "the students of the time of the Han, knew the characters but not the sounds."

This was well understood by that learned Egyptologist, the late Mr. C. W. Goodwin, carried off by death soon after his arrival in China. In the only article, or note rather, so far as I know, published by him, on this subject, in which he took a brief interest, he refused to believe that the Chinese writings had been always composed on the principles taught now-a-days; he refused to believe (*e.g.*) that the character *siang*, composed of two hieroglyphs, one of them "tree," *muh*, and the other "eye" *muh*, could signify "mutually," and be pronounced as *Siang!* Had it been permitted him to pursue his investigations, and to study the ancient forms of writing, he would certainly have discovered that which I am now endeavouring to elucidate.

The legend of the *Luh-shu*, or "Six-Writings," which has taken shape purely from the interpretations and systemisings of the philosophers of the Han, and which has been so great a stumbling block to the true understanding of the composition of the characters, assuredly had its source in an ancient recollection brought to China by the "Hundred Families." The old legends of Chaldæa are filled with the six manifestations of the Divinity, which, doubtless, corresponded to the number of the sacred books in which the priests beheld the most complete exposition of the revealed law.

The mode of writing called *ta-chuen*, of which we have stated that the *siao-chuen* was a systematic reduction, in conformity with a canon of a certain number of strokes (or elements), was formed by the historiographer, Shœ Chœu, by order of King Suen, one of the greatest monarchs of the Chœu dynasty. This prince's intention (which failed through the weakness of his successor) was by presenting this system to the feudatory States, to restrain the disorder which the absence of any sufficient powerful centre of literary unity had suffered to arise in the use of the written characters, which was then almost entirely phonetic, and thus necessarily followed the dialectic variations of the different principalities. In this undertaking the written character was reconstructed as one of hieroglyphics. This event in the history of writing, of which the importance is unmistakable, but which has never, till now, been pointed out, had no small influence on the destinies of the Celestial Empire. It was imitated at a later date, though on a smaller scale, as we have already mentioned. If it has, in truth, aided the spread of the Chinese power, and facilitated its maintenance over a too vast area, it has, at the same time, been a clog, so far as its action could go, upon its development, in the sense in which this expression is understood among the higher races, to whose progress the possession of an alphabet, a thing rendered impossible by this event among the Chinese, has contributed so immensely.

Shœ Chœu, ill-omened genius that he was, made it his object, by choosing, whenever it was possible, characters that symbolised objects in harmony with their significations as these were understood by him under the prejudices of his age and surroundings, to render these characters, by some modifications of, or addition to, the strokes as much as possible images. And when the newly mixed outline of the sign of any idea was not enough of an image to be understood without the pronunciation belonging to it (which was only limited to some dialect or other), he attached an additional figurative sign. The phonetic principles which evidently guided him in the selection of characters, both figurative and otherwise, have not come down to us, although at a date after the

"burningof the books," there appears in a catalogue a treatise on writing bearing his name, which has since disappeared in one or other of the literary catastrophes of the great Empire. However, after the examination of the characters which he had formed, it would seem that he endeavoured with care, and often with success, to group two homophones in such a way that one of the elements, simple or compound, of a word-group should mark plainly, by its particular phonetic value, the official pronunciation attaching to the object indicated by the whole complex symbol.

Let us remember, in apology for this remarkable man, that the ancient traditions regarding the process by which the characters were formed were no longer generally known, and that in some of the States, viz., those in which literary culture was least developed, they could only imitate the ancient outlines without understanding them. And this we are able to discern by comparative study of the ancient inscriptions, even in spite of the mist of 3,000 years that separates us from those times.

As an instance of the method of Shœ Chœu, to indicate the value "earth," he found that the old sign, *t'u*, was not sufficiently intelligible, so he added *tun*, indicating "an earthen dyke," as suggestive of "earth."

In complex characters, when this same character *t'u* played the part of an ideograph or a phonetic sign, it was replaced by *feu*, "hill," which appeared to him more suggestive than the old one.

The modern character (Kiai-shu) can, therefore, only be a stumbling block in the study of the ancient word-characters. When the old elements composing them have not been intentionally changed or modified in the transition of styles, they are, for the most part, mere imitations. Thus it may be affirmed, without hesitation, that the modern Chinese is, orthographically, a mere phantom of the ancient.

But to resume, one would not expect to find in the modern Chinese character (which in its present form is no older than the 4th century of our era) the exact reproduction—exigencies of style excepted—of the ancient orthography, did one bear in mind that the modern character was only formed after several successive and systematic modifications. These modifications were called for partly by political exigencies requiring an ideographic uniformity of character comprehensible in the different dialectal districts of the Empire, partly in accordance with philosophical speculations for which the old phonetic expressions were insufficient, partly again by the improvement in writing materials.

The archaic character is composed of a certain number of heiroglyphic signs, of which the symbolic value has, in many cases, been preserved, while in another considerable class of examples, this signification has been lost, and appears never to have been known by the Chinese. In fact, although their hieroglyphic origin cannot be matter of slightest doubt, their symbolic value had been lost at a period anterior to the oldest records or traditions of Chinese culture.

Besides the foregoing, the characters included a certain number of signs without any possible explanation, and known only by their phonetic value and significations traditionally attributed to them. All these symbols, by their double, sometimes triple combinations, formed a supplementary class of complex signs, amounting, according to prevalent tradition, to a general total of 540. But as the object of an ideographic sign often has several designations, the supplementary sign served as its phonetic complement, enabling the reader to recognise which pronunciation was to be employed in each individual case. This enables us to establish a basis of comparison between a number of different uses of the same symbol.

For the present, it will suffice to give you a few specimens, illustrations, and examples of the old system of phonetic transcription completely forgotten for more than 3,000 years, even in the countries where it was practised.

We now reach the most curious fact of our investigations, and which, I hope, you will listen to patiently, laying aside all preconceptions as to the peculiar originality of the Chinese language and nation; as to their self-contained development in isolation, from all the other civilisation of the world; and as to the notion that China is a world by itself, which has independently originated the arts, the sciences, and the written character which it possesses.

The detailed exposition of the researches undertaken by me during many years, guided by the methods of modern linquistic science in this unexplored dominion, would be beyond the limits of the present paper, and I can only ask your indulgence for a summary of the results.

These researches have been supplemented by the written character from its last transformation in the 4th century of our era back to the most ancient graphic written monuments; the study of native works on phonetism, of ancient rhymes and dialects; the transliteration of proper names at different periods; and by the comparison of the vocabulary of modern dialects, whether within or without China proper, a comparison which has been extended, first to cognate languages, according to their degree of relationship and the greater or less degree in which they have participated in Chinese literary culture, and then to more remote idioms, according to the importance of the affinity with Chinese which they present.

These studies have led me to recognise in the Chinese spoken language, excessively attenuated as it is now, and disguised by the influence of idioms belonging to a different morphology and idéology, an ancient member of the great family of agglutinant languages, known as *Ural-Altaic*. And in doing so, it may be necessary to establish a third division of that family's group which has been provisionally constituted by recent discoveries, and which might appropriately be called Amardian; a group in which the first division embraces Akkadian and its dialect, and the second division proto-medic, Susian, and Kossian.

It was necessary to disregard at the remote epoch in the history of spoken Chinese with which we have dealt, its characteristic phenomenon of *Sheng*, improperly called musical intonations, owing to their being of subsequent date. These *Sheng*, so strange to our ears, accustomed to the *recto tono* languages, have affected in different degrees a certain number of the languages of the extreme East more or less related to Chinese, in which, as also in the Chinese, they have reduced the words to a relative and modern monosyllabism. This phenomenon is found also, but in a less

degree, save perhaps, in Houzouana, in many African dialects, where it has produced the same result. The more immediate cause of its existence has been, and still is, among the languages in which it is now found, the natural compensation necessary to counterbalance the contractions, aphereses and apocopes, according to the fenius of the dialects, the simple or compound vocables of which have been affected by that muscular sloth which is the particular disgrace of those peoples, but which acts in accordance with the ideological sense of the speech of those who make use of them.

Having thus recognised the part played by the *Sheng* in the history of those languages now known as *vario tono*, let us recur to spoken Chinese for the purpose of mentioning certain peculiarities of phoneticism which it shares with the Amardian division of the great family above referred to, and which, coupled with its ideological characteristics, place it as a limit between that division and the Ugro-Finnish group.

It is impossible for me, without trespassing on your patience, to enter into the minute and numerous details respecting the decay of letters, the varieties of pronunciation, and the choice of certain articulations, which closely connect ancient Chinese with the Akkadian and Susian dialects, and not with the Ugro-Finnish tongues, with which, on the other hand, it shares certain very marked grammatical affinities. I cannot do better than show you here the resemblances between the Chinese and Amardian vocabularies by citing, from a list of upwards of many hundred examples, a few words common to ancient Chinese and Akkadian :—

	Akkadian.	Chinese.
To shine	mul	mut
To purify	lax	luk
Region	ub	ip
White	par	bak
Cloth	sik	sik
Strength	sur	sek
Write	sar	suk
Right	zag	dzek
Book, writing	kin	king
To know	zu	si(t
To destroy	zir	dzok
To die	mat	mut
To give	sim	seng
Horn	sî	tse
Weak	sig	dek
Full, complete	sig	sik
Variegated	dar	dok
To grow	dar	dœk, dok
Hero	dun	tan
Leaf / Tablet, to write	dub	dep, tap
Knee	dugu	dok
Vase	duk	tuk
Lord / Man	elim / erim	lang
Prince	khan	kan
Woman	rak	nok, luk
Settlement	pin	pin
Mother	umuk	muk
Mouth	ka	ko
Door	kâ	ga
The earth	kia	kai
Under	kita	get
Earth, country	kiengi	kien kai
To eat	ku	ki(t?

	Akkadian.	Chinese.
To be high	kuga	kok
Slave	pak, nar	pok, nok
Sunrise	kun	kan
Earth, country	kur	kok
Favour	kur	kuk
Fish	xa	gu
Cloud	gan	gun
Curved	gam	gam
Black	gik, mi	kek, mi
Son	tur	tak
One	it	it
Cow	lum / lub	lu
Brick	ku	ku
Judge	di	ti
Cent	me	be
Eye	si, mat	si, mut

It seems to me unnecessary to draw your attention to the peculiarities of primitive hieroglyphicism, of polyphony, of the system of phonetic complement, and, at the same time, of the relative age of the archaic writing of the Celestial Empire, at the period of its first introduction, when one can compare them with like peculiarities observable in the earliest cuneiform inscriptions, with which we have become familiar through the discoveries made in the field of Assyriology, of which the distinguished General Sir Henry Rawlinson is the creator and the chief.

No more doubts exist in respect to the cuneiform characters than in the case of Chinese signs, that they have degenerated from ancient hieroglyphics; but the outline of the ancient images is, in the cuneiform, far more obliterated in consequence of the peculiar and inexplicable form of the cuneiform strokes in which, from the earliest times, they have imitated. In spite of this, the images are yet occasionally recognisable, and some help may be derived, although not in an absolute manner, from the linear outlines of these same characters which, however, ought not to be regarded in the same way as their graphic precursors, since they, at times, give evidence of a greater corruption of the primitive image than the archaic cuneiform outline. The cause of the preference shown for a linear outline, in the last case, should probably be attributed to the hardness of the substance upon which they were engraved with greater facility than the cuneiform strokes, which, on the contrary, were more easily printed on tablets of unbaked clay.

We must always remember, however, that the fact that the earliest characters were a combination of linear and cuneiform strokes, shows that the primitive outlines were made by joined lines, and it was thus, doubtless, that the writing on bamboo, papyrus, or ölet, which preceded the use of the clay, was tried. But, however that may have been, and although the number of the signs of which the hieroglyphic value is now known is small, and yields but a limited field for comparisons, the resemblance between these hieroglyphics and those that have been preserved in China is very striking, and indicates, without doubt, a community of origin. The identity of outline, as far as it is possible to recognise it, the identity of sound and of meaning, and the common possession of the same polyphonistic values, can but point to one conclusion. We should also remark a characteristic of this hieroglyphic writing, and which distinguishes it from that of ancient Egypt. It is that in China, as in Chaldea,

the images are drawn full face, whereas, in Egypt, they are shown in profile. Undoubtedly there is an importance to be attached to this peculiarity.

Let us take some instances of resemblance between the two writings, and compare the linear or the archaic cuneiform outline of Babylon, with the Chinese Ku-wen. Apart from this test, there are reasons for believing that the cuneiform writing was not always arranged in horizontal lines. Without mentioning the peculiar arrangement of the characters in some of the most ancient seals, which seem to lend themselves easier to a vertical than to a horizontal system of writing, and without the additional fact that the early writers on stone wrote horizontally, we shall notice, with the eminent M. Sayce, that a greater part of the images which seem as though, ideographically, they should be considered upright, are written horizontally in the linear form of inscription.

The following are some hieroglyphics that are common to both writings: — "Eye," "moon," "augur," "north," "divining-rods," "race," "family," "tongue," "slave," "black," "region," "protection," "settlement," "brick," "bull," "rope," &c.

It will be noticed that we have avoided comparing the signs meaning "mouth," "sun," "star," "moon," "tree," and others of the same kind, which could not be represented, excepting in the same manner, and consequently would be without value.

These resemblances in sound and in words, and this identity of original writing, are only of marked value where supported by like affinities in the literature, and in the traditions. Of this we will proceed to give proof.

The Yh-King is, *par excellence*, the holy book of Chinese literature. I cannot better describe it than by quoting the recent description given of it by the learned professor, who has so kindly offered to preside here this evening:—

"Among the most valued works of antiquity stands the 'Yih-King,' the original text of which consists of short sentences, arranged under certain diagrams, formed by the combination of straight lines, and is attributed to the legendary Emperor Fuh-he (B.C. 2852). But, whoever may have been the author of this text, its antiquity is undoubted, as is incidentally shown by the increasing inability of the successive early commentators —Wan Wang (B.C. 1150), Chow Kung (B.C. 1120), and Confucius (B.C. 500)—to understand its drift. 'If I had 50 more years to live I would devote them to the study of the 'Yih-King,'' said Confucius, as he laid down his pencil at the completion of his commentary on that work, in which, however, he professed to find an unfathomable abyss of philosophical learning and divinatory lore. The superstitious fame which the sage thus established for it saved it from the *auto-da-fé* in which perished (221 B.C.) the entire literature current in the northern portions of the empire, except such works as treated of medicine, divination, and husbandry. Since that time, the foremost scholars of each generation have edited the text, and heaped commentary after commentary upon it, and one and all have arrived at the somewhat lame conclusion, that its full significance is past finding out. In the same way, a host of European Chinese scholars have made translations of the work, and have, if possible, made confusion more confounded. The text, as we have it at the present day, is very corrupt, owing to the fact that it was re-written at least three times, at the three great official modifications of the characters referred to above, at each of which it suffered mutilations at the hands of the transcribers, who introduced changes in the ideographic value of the characters to suit the philosophical views prevailing at the time, and in the phonetic values of others, in accordance with the peculiarities of the existing official dialects. But in spite of these difficulties, the knowledge possessed by M. Terrien de La Couperie of the ancient sounds of the language and of ethnological science, has enabled him to raise the veil from the 'Yih-King,' which has resisted the searching gaze of 30 centuries of native scholarship, and to foreshadow the true nature of the work."

According to the necessarily brief examination given by us to the two chapters which we have completely translated, and which are of a like character, the Yh-King would seem to be an agglomeration of very ancient documents. Out of the chapters that we have translated, the 22nd and the 30th are simply lists of meanings of the hieroglyphic placed at the head of the chapter. These lists are drawn up with care, and seem to have been made systematically as vocabularies; and in order to give the precise meaning, the author has occasionally been at pains to show the significations expressed by homophones, which should not be attributed to the sign which is the object of the chapter. Without being as yet in a position to affirm this positively, we think that, at least, half of the book is composed of such lists. Certain of the chapters relate to the early populations of primitive China, of which the name and the particulars are recognisable. Some seem specially effected to certain categories of objects, the different kinds of which are indicated; some treat of certain customs; some, again, seem to be connected with the events of early ages; others seem to be ephemerides, and relate to celestial phenomena, as in astrological works; while others, again, appear to be geographical or ethnological enumerations. One chapter that we have translated is devoted to a series of customs, specifying those people who were wont to practise them. The whole forms a subject of the highest importance for students of the ethnography of past times.

If, for instance, we examine chapter 30 (of which I recently gave a translation to the Royal Asiatic Society with philological commentary), we shall see a hieroglyphic having the sounds "lœp" and "dip," of which the earliest representation is a horned mammal, described in the first line of the text as "a cow," and then come six other lists of characters of which no sort of connected sense could be made, as may be seen from the great discrepancies in translation offered by those who have sought to arrive at their meaning. But these characters exactly represent the very complete series of the different significations of the hieroglyphic expressed phonetically, and of which a great part are yet attributed to the same character. Many of these, however, are unknown in Chinese literature, though they are expressed in its vocabulary by the same phonetic type. These lists are broken up here and there by formulas of augury, "lucky" and "unlucky," notably by words such as *Lœh dœnk* and *dœnk-kœ*, which singularly enough recal the formulas *la-dunku* and *dunk-hu*, preserved in the cuneiform astrological tablets.

The corresponding hieroglyphic in Akkadian writing, which is identical in form, and which signifies "ox," has the sounds of "lup" and "dip." The fragments of dictionaries, better

known under the name of cuneiform syllabaries, wholly unpublished and unedited, and which Mr. T. G. Pinches has kindly consented to collect for me, furnish an incomplete list of the same meanings. In one of the syllabaries, six or eight lines, containing as many significations of this same character, are missing; but, happily, among those that have been found on other cuneiform tablets, figure those which, while indicated in the lists of the Yh King, are wanting to the same hieroglyphic in Chinese literature. The accuracy of our discovery is yet further proved by the composed characters in the two writings.

To summarise. Certain portions of the Yh King are only lists of meanings that pointedly recall the Akkadian cuneiform syllabaries, and which belong to one dialect of the same family, and we shall see, by an example, up to what point of identity this resemblance consists. The imagination has here wide scope to supply the lines that are missing, and it is hard not to try and foresee that which would confirm us from the new discoveries in Chaldee.

The syllabaries on which we have founded our examples only date from the 12th century; it is true, they are exactly copied from those of the ancient library, compiled by order of Saryukin, king of Agadé, in the sixteenth century before our era. As to the precise degree in which these syllabaries are an abridgement from still earlier ones we know nothing. But after our investigations, and after the occurrence in the early Chinese lists of meanings and expressions found in the Assyrian texts, and which, therefore, do not figure in the syllabaries, we may be led to believe that there were lists in every way far more complete than those which have come down to us, and it is to be hoped that new discoveries may serve to confirm this theory.

All this, of necessity, implies an early relationship between Chinese and Chaldean culture, around which we shall yet group several curious facts drawn from the old sources of semi-historic Chinese tradition.

We do not look on the progressive development of civilisation in China. The first chiefs and their ministers were in possession of most of the arts and sciences. They were only concerned in installing themselves in the country, and in forming relations with the populations, or in organising an administration upon a plan fixed beforehand, or in conformity with an earlier experience.

All the inventions, astronomy, music, medicine, as well as all the arts that add to the comfort and the well-being of mankind, are attributed to the legendary group of Nai Hoang-ti and his ministers. Under Yao and Shun there are questions as to the titles of officers which have never met with any explanations to this day, and which remain problems.

Hoang-ti (originally pronounced Kon-ti), according to legendary tradition, was the first of the five emperors who reigned at the dawn of history. His family name was *Nai* (originally *Nan* or *Nak*). If we examine the ancient form of his name, as it is shown in the old Chinese palæographic collections, we shall find that it is made up of a single group, pronounced Nak-kon-ti, a name which coincides strangely with Nakhunta or Nakhunte, mentioned in the Susian texts as the chief of the gods. His name was added to theirs by the early kings of thi region. Kudur Nakhunta, King of Susa, cam down to the plains of the Euphrates, ravaged th country, seized upon the towns extending fron Ur as far as Babylon, and founded in about th year 2285 B.C., the dynasty that, according t Berosus, is called Median.

The same records tell us that the inventor o writing was Ts'ang Hieh, whose name, accordin to ancient Chinese, was pronounced *Dum-Kit* This man is said by some to have been an indepen dent chief; others have described him as comin to the throne after the fabulous Fuh-hi; whil others, again, have termed him one of *Nakonti'* ministers. The resemblance between his name Dum-Kit, and that which Dungi, King of Ur, late on certainly bore, for the same reason that the sur name Nakhunta was given to all the kings of Susa, is curious; and our interest in the comparison reache a higher pitch when it is seen that the Akkadian characters forming the name of Dungi, mean "the man of the bamboo tablet," and that that of the two Chinese characters with which his name was written in the earliest times was "carve of wood."

Tsoh Kieu Ming, a disciple of Confucius, has preserved in his *Tsoh chuan* a tradition reported t him by the sage himself, and which, bearing on the subject of writing, seems worthy of general attention.

"In days of yore Hoang-ti used signs in the form of clouds (Yün) in order to record facts.

"Yen-ti made use of signs in the shape of tongues of fire in order to record facts."

But these signs in the form of clouds, may they not possibly be taken to mean shadows of the objects? *Yen-ti*, in old Chinese *Din-ti*, is the surname of *Lieh Shan*, in old Chinese *Lik-tan*. In this have we not a far-off recollection of the celebrated *Liktiam* (Lik bagas, Lik babi), the earliest known King of Ur, who has covered the whole of Chaldæa with his monuments, while *Din-ti* recalls singularly enough the aged seer of Babylon, *Din-tir*. And those tongues of fire that he was wont to use, may they not be the cuneiform characters?

As regards the political institutions of primitive China, in the fragments of Susian history as far as they have come to light, we find some explanations upon two points that have hitherto defied the research of students, whether natives or foreigners. In the second chapter of the "Shu King," we learn that the Emperor Shun (2255-2205 B.C.) gave daily "audiences to all the pastors," a term that is understood to apply to the princes of the various States. In another passage it is said that he made special sacrifice, but with the ordinary rites to God, and with purity and respect to the "Six Honoured ones." The epithet "pastors" applies to the Princes, and the term "Six Honoured ones" have been the subject of many commentaries, without, however, any satisfactory result having been arrived at. But we see from the Susian texts that the word for "Prince" had the meaning of "Pastor," and that in the Divine hierarchy immediately after the chief deity were six gods of inferior rank.

An officer of high rank, whom Yao and Shun

consulted, and who seems to have played an active part in the regulation of the affairs of the Government, bears the title of Chief of the Four Mountains. This strange name would seem to have reference to a yet recent reminiscence of the famous title of "King of the Four Regions," which was one borne, as is well known, by the Chaldean sovereign.

One of Yao's first tasks was to divide his dominions into twelve sections, presided over by the same number of chiefs; this is absolutely like the duodenary feudal system adopted in Susa. We know that to Yao is attributed, and with the greatest probability, the establishment of the cycle of sixty years, the length of the year, of months, and the intercalary month.

The names of the four cardinal points, and, what is very remarkable, the hieroglyphic signs by which they are expressed, are, in a certain measure, the same in the Akkadian and Chinese cultures. This I intend to show in a special monograph upon the subject; but that which is here of importance to note is the displacement of the geographical horizon produced in the establishing of the "hundred families." The South, which was so termed on the cuneiform tablets, corresponds in Chinese to the East, the North to the West, the East to the South, making thus a displacement of quarter of a circle. It would be interesting if, on examination of the Akkadian and Assyrian names, we could find that they, in their turn, denoted an early displacement, of which only these traces remain to us.

In the present day in China, the left hand, that is the west, is held to be auspicious, and is looked upon as the place of honour. On the other hand, in early Chinese, just as in Chaldee, it was the right that was so regarded.

The eight Kwa of Fuh-hi recal, in a singular manner, the arrows of divination that are almost always eight in number, and which, as the Babylonian Assyrian cylinders show us, are held in the hand of Marduk and of Istar. These are shaped in the form of a circular fan, and exactly answer to the description given by the Mussulman authors in their account of the heathen Kaabah rites; their disposition is precisely that of the eight Kwa which Fu-hi holds in his hand, in the well-known ancient Chinese portrait of him.

Belomancy was much practised by the Chaldeans. And I would remind you of the curious passage in Ezekiel, where the prophet states that Nabuchodorossor, before setting out for the war, and while yet hesitating as to the proper point where he should attack the foe, put arrows unsorted into a quiver, after having written on each, according to the commentary of S. Jerome, the name of one of his adversaries, in order to see which one would come out first, and consequently which town it was that he ought to attack. This same belomancy is still practised among the Arabs, and was very prevalent in Mecca at the time of Mahomed.

According to Mussulman writers, seven arrows without points or feathers, and each bearing a significant word, were preserved in the Kaábah, under the guardianship of a special minister.

We cannot here examine how far it would be possible to re-discover and to group the traces existing in this Akkadian character of an older method of writing, either invented or imported by a people of a different race; a writing, doubtless, incomplete and coarse, and certainly figurative, but which met with its perfection in the Akkadian centre, with which it became wholly assimilated, and upon which it has left its indelible stamp. It is the writing itself which yields us knowledge, respecting certain physical characteristics of the people, by whom it was at last systematised. Thus, the hieroglyphics still preserved in China, show us, from the peculiar outline of the nose, when seen full face, that that member must have been usually quite flat. Unfortunately, this symbol cannot be compared with the Akkadian character, for this, we believe, is not yet known.

The obliquity of the eyes is illustrated by many examples in the simple and composed characters, in the Kuwen of old China. And the two linear outlines which, in Akkadian, denote the eye (outlines that have been clearly misunderstood), seem with every probability to confirm the same fact.

In the lectures given by the talented Professor Sayce, some two years back, on Babylonian literature, he made allusion to the oblique-eyed population of Babylon. The learned Assyriologist was kind enough to inform me that he had come to this opinion, after an examination of the figures represented on archaic cylinders, but that the dwarfed and clumsy outline of these figures should not rank as proof, since the acquisition by the British Museum authorities of the statuettes of Gudea, Viceroy of Zirghoul. The type of this personage is, indeed, a different one, though it may not be Semitic; yet it seems to us that it cannot be invoked in matters concerning the type of the higher populations of Elam. The bronze statuettes of this monarch represent him in a singular posture, doubtless sacred, for the accomplishment of some traditional rite, for he is shown kneeling upon some special kind of support that is lost to-day, and made, probably, of some different kind of substance, and in his hands he holds an enormous bludgeon, broad at the top and narrow at the base, but of which the point, though unfortunately broken, is yet sufficiently indicated. The form of this tapering staff recals that of those cones of baked clay that were probably designed for some religious rites, and of which the most bear inscriptions of this same Gudea. On the larger part, there is a kind of border, from which, as Mr. T. G. Pinches shrewdly observes, they were probably intended to hang point downwards. Such precaution, if we compare it with the kneeling posture of Gudea, would seem to indicate a special veneration, a great respect, for this point. From a hieroglyphic preserved in China, we may get an explanation of this. As is known, the hieroglyphic sign for father in Chinese *ku-wen*, more or less faithfully imitated in modern writing, passing by the intermediate styles, *ta-chuan*, *siao-chuan*, and *li-shu*, represents a hand, the right, grasping, or, rather, exhibiting an object delineated by a stroke sometimes thick at the top and fine at the bottom, and *vice versa*, just according to the interpretation put upon it by the scribe, whether "stick" or "flame," between which the etymological traditions concerning it are divided. These two traditions, as is so often the case in China, are they not both correct? do they not each represent a part of the truth? Without entering into the question as to whether the affinity of the

name Gudea with the ancient reading of the Chinese hieroglyphic *Gut*, which is still preserved with the special meaning of dead father, be purely accidental, or whether it is likely that the two names may have had one common origin, we are led to believe that the Chinese hieroglyphic, the bordered cones, and the attitude of Gudea holding his stake, all serve to explain each other. This cone of wood may almost certainly be taken to mean the generator of fire, like the *pramantha* of the vedic hymns of which, as M. Boscawen shows, its use in religion was known among the Akkadians. It must yet be insisted that in the statuette there is much wanting to admit of our drawing any conclusions as to the physique of the Akkadians of the higher classes. It belongs to an epoch subsequent to the predominance of the Turanian element, and seems to argue a growth of the Mongol and of the semitic types.

We could enumerate a long series of affinities between Chaldean culture and Chinese civilisation, although the last was not borrowed directly.

From what evidence we have, it seems highly probable that a certain number of families or of tribes, without any apparent generic name, but among which the Kutta filled an important position, came to China about the year 2500 B.C. These tribes, which came from the west, were obliged to quit the neighbourhood, probably north of the Susiana, and were comprised in the feudal agglomeration of that region, where they must have been influenced by the Akkado-Chaldean culture.

The numeric formalism which plays so great a part in all Chinese conceptions, which penetrates their ideas, their customs, their institutions of every kind, is notoriously of Chaldean origin. Although, however, on this point there is yet much to be learnt, and although we must wait for the revelations of those Assyriologists who are now at pains to decipher the tablets relating to the sacred numbers that have been added to the collection in the British Museum by a well-known modern Assyrian, Mr. Hormuzd Rassam, yet we may already see how great, how important, was the use of these numerical categories in the cosmogony, the institutions, and the speculations of the ancient Chaldeans. Of them all, the numbers twelve, seven, and six are chiefly remarkable.

I will not trespass further upon your patience by citing the vast number of affinities already pointed out by learned men, such as Davies, Chalmers, and Schlegel, between a host of our customs, our sciences, our arts, our superstitions, our games, and those of the subjects of the Son of Heaven. A portion of these are certainly owing to their progress, as also to communication and to ulterior changes, but another portion, perhaps the earliest and most important, traces its origin to the first establishment in ancient China of a part of that primitive Akkado-Chaldean culture to which our modern civilisation are indirectly so referable.

MISCELLANEOUS.

RAILWAY ACROSS NEWFOUNDLAND.

Newfoundland, the oldest of our colonies, does not yet possess a single mile of railway. This defect, it is announced in *The Colonies and India*, will shortly be remedied. A survey has been made of a route for a line right across the island from east to west, and the Colonial Legislature has committed itself to its immediate construction. Starting at St. John's the line will take a south-westerly course for 30 miles, and, gradually bending to the north-west and west, will pass along the narrow neck of land which separates Trinity Bay from Placentia Bay. Hence it passes in a general westerly course to St. George's Bay on the west coast. The country to be opened up by this railway is well watered and well wooded, resembling in a great measure in general features the Cumberland Lake District, intersected with lakes and with considerable hills rising here and there above the general high level of the land. The highest land actually traversed is 1,100 feet above the sea, and the total length of line will be about 350 miles, the actual distance from terminus to terminus, in a direct line, being 275 miles. Much of the country to be traversed has hardly been visited by other white men than the actual surveying party, and it is described as affording rich pasture land, and as containing abundant supplies of minerals. The district in the neighbourhood of the western terminus, St. George's Bay, is one of the healthiest districts in the world, being free from fogs and from the occasional severity of the weather felt in other parts of the island; and there is no doubt that, when the railway is completed, settlement there will take place very rapidly, and it will become one of the health resorts of the island, and probably of the adjoining continent as well. It is hoped that eventually communication by means of ferry steamers will take place between St. George's Bay and the mainland, thus enabling passengers and goods to be carried without change of train from St. John's to any part of the Dominion of Canada. This would be a saving of about 1,000 miles of sea voyage; and, whether this scheme should ever be accomplished or not, the opportunity which the railway will afford of avoiding the dangerous and unpleasant navigation between Cape Ray and New York or Quebec will be seized by many travellers between Canada and England. The further advantages of opening up the hitherto neglected resources of Newfoundland by means of a line of a railway are obvious.

GENERAL NOTES.

Direct Applications of Solar Heat.—Since May, last year, M. Mouchot has been carrying on experiments near Algiers with his solar receivers. It is stated that the smaller mirrors (0·80 m. diameter) have been used successfully for various operations not requiring more than 400 deg. to 500 deg. Among these are the fusion and calcination of alum, preparation of benzoic acid, purification of linseed-oil, concentration of syrups, sublimation of sulphur, distillation of sulphuric acid, and carbonisation of wood in closed vessels. The large solar receiver (with mirror of 3·80 m.) has been improved by various additions. This apparatus, on November 18, last year, raised 35 litres of cold water to the boiling point in 80 minutes. On December 24, M. Mouchot with it distilled directly 25 litres of wine in 85 minutes, producing four litres of brandy. But, perhaps, the most interesting results are those relating to mechanical utilisation of solar heat. Since March the receiver has been working a horizontal engine.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

POSTAL TELEGRAMS.—DEPUTATION TO THE POSTMASTER-GENERAL.

A deputation to the Postmaster General from the Council of the Society attended at the General Post-office, on Saturday, July 17th. Present :—Lord Alfred Churchill (late Chairman of Council), Admiral Sir F. Nicolson, Bart., C.B., Rear-Admiral Mayne, C.B., Andrew Cassels, Edwin Chadwick, C.B., G. C. T. Bartley, and H. T. Wood (Secretary). They were received by the Postmaster-General, the Secretary, the Financial Secretary, the Assistant Secretary (Mr. Patey), and other officers of the Post-office.

On the introduction of the Deputation,

The Postmaster-General said that he had read the memorial of the Council (printed in the *Journal* for July 9th, p. 707), and had fully considered it.

Lord Alfred Churchill said—We attend here as a deputation from the Council of the Society of Arts, to urge upon her Majesty's Government, through the Postmaster-General, the expediency of a reduction in the rate of inland telegrams from one shilling to sixpence. I may mention that I was formerly connected with the early establishment of the shilling rate, having belonged to the original shilling telegraph company, since purchased by the Government. We had ten years' work in establishing it. The amount of telegrams at that time was an average of about six millions a year, and I believe that the amount is now about twenty-six millions a year. We are fully aware of the great difficulties which the Post-office authorities have had to encounter in establishing the telegraph system throughout the country, and in extending it as they have done, and also of the admirable manner in which the work has been conducted and carried out by them through many trying circumstances. You have had great expenses, no doubt, in making extensions, and in organising a system which has developed itself into one of such immense proportions, far exceeding the expectations of the original founders of the system. Her Majesty's Government have now had possession of the telegraphs for ten years; as it was in 1870, I think, that they took over the companies; and we beg most respectfully to submit that the time has now come when the public might very well receive further benefits, by the reduction of the minimum charge from one shilling to that of sixpence. The memorial presented to you, sir, in which we have carefully avoided mentioning or detailing any special method by which that should be done, gives reasons why we think it should be done; but we have thought it better to leave the matter to the authorities, rather than to suggest a method of our own. There are several methods which, individually, we may prefer. I may say that a charge of sixpence for ten words would be sufficient, leaving the surplus words to be charged for extra. A method has also been suggested by which a word tariff might be adopted. But this we would leave to the Post-office authorities to determine as they may think fit, should they be disposed to grant our prayer. Therefore I will not go into details, but simply ask Mr. Chadwick to follow up what I have said, and, with his experience, to go thoroughly into the matter.

Mr. Edwin Chadwick, C.B.—I beg leave, defensively for the past as well as for the future, to advert to the fact that the telegraph companies, in their manifesto on the proposed change, declared that the Government had no other authority for putting their undertakings on a public footing than my own, and that the plan was destitute of practicability; and that the uniform shilling telegraph then proposed would not materially increase the returns beyond those which they received. I have no responsibility for the initiation of the mode of purchase; but the answer to these predictions of the private companies is now, that the number of telegrams when the service was in their hands was, as has just been stated, six millions, and it is now more than twenty-six millions. Apart from the really minor question of gain to the revenue, what has been the gain to commerce by the change, of which some account should be taken? Now, it has been estimated that nearly half the messages are commercial messages; that is to say, there are some twelve millions of them annually. Every message has been estimated, one with another, to save a day of business time; and the value of a day of a business man's time has been taken as worth ten shillings. Here, then, there is a saving of six millions worth in money of business time annually. By those who may conceive the estimate of time, the gain of time and value, too great, let it be halved if they will, and it gives three millions annually of money saving, or double the total revenue of the telegraph. This estimate, I believe, cannot be fairly reduced; but I am very certain that people have no clear idea of the collective magnitude of the saving of time to the commerce of the country by telegraphic communication. If the saving were only of half days; on the average, it gives an aggregate saving of 16,000 years; in fact, it gives what may be called an annuity of 16,000 years more of time to commerce, at one-third less of cost, than was given by the private companies. Let that estimate be lessened, if you will, and consider the lowest result; for there is more saving yet. Howsoever it may be with the business man's time, there is to be considered the gain of time in speeding the transit of goods, in saving stocks, and in speeding the turnovers of capital. It operates to the saving of stocks in the provinces by enabling the dealers there to telegraph for goods, as they are wanted, to the central markets, in London and elsewhere, at home as well as abroad. The telegraphic service operates to quicken the turnover of capital, and to enable business to be done with less amounts of capital, and to be done quicker at lower charges to the consumers. It is stated that business, by these quickened turnovers, is often transacted with one-third of the capital formerly required. These are factors greatly needed to be further worked for the relief of the present manufacturing and commercial depression. On these accounts, while there may be losses on the direct tax to the revenue, there will be gains to the public; and, as an economic principle, taxes on the transit of information, as of goods or passengers, will be found to be here, as on other topics, the most wasteful of taxes. At present, the habitual use of the telegraph for business transactions is restricted

to a small number of the higher class of business men. What is wanted, is to extend its use by a reduction of charges, especially to the agricultural classes, by whom, so far as is known, it is now very little used, as compared with its use in Belgium by agriculturists, having half-franc telegrams. Tradesmen in London have declared that they would send three or four sixpenny telegrams for one shilling one now sent; local postmasters have confidently expressed their belief in the large augmentation of numbers that would be produced by a reduction of price, and that their time, now only occupied a part of the day, would be fully occupied by sixpenny messages. On the Continent the numbers of telegrams have been doubled, by the substitution of half-franc for one franc messages. Reliance may be placed on the fact of more active habits of business inter-communication in England than on the Continent, by letter as well as by telegrams; and that when the results obtainable by reductions of prices are as two on the Continent, in England they will be as three. There is an apprehension entertained that the present officers of the department would be opposed to improvement. The advance of scientific improvement has been far greater in the department than it had been or could be by private companies. According to all testimony, the telegraphic department of the Post-office is really in advance of the private telegraphs in America, or of the public work on the Continent, in all except price. It is only exceeded on the Continent in the utilisation of the local offices for parcel post collection and the small parcel distribution, which, at this time of depression of trade, specially needs extension. The real source of opposition to change and improvement apprehended it must be and is the Treasury, whose hostile action in regard to the telegraphic department calls for investigation. That hostility has been displayed in charging to revenue extensions which, in all well-established practice, are charged to capital, and thus making it appear that there has been a deficit at a time when there has been in reality a surplus. It has been a matter of observation amongst business men that if the like practice were pursued in the administration of railways that has been followed by the Treasury, there would now scarcely be a dividend-paying railway in the country. As a late particular instance, they might have seen that the whole expense, £30,000, of a new office in Manchester was charged to the year's account. In my first service in Poor-law administration, the charge would have spread over 30 years. Added to this depreciation of results, there have been the improper conditions of the original purchase, and of a monopoly which Sir Rowland Hill had agreed with me was not needed, which occasioned the service to be hindered by extravagant compensations of private enterprises, some of which were set up in order to be purchased. All this has gone in depreciation of the measure first proposed, and the principles of administrative improvement, which call for vindication. With allowance for these and other shortcomings, in so far as the administrative principles elaborated by Sir Rowland Hill have been carried out, the whole department will be found to be the best administered public service in this country, and probably in Europe. It is confidently expected that, by the influence of the eminent political economist whom I have the honour to address, the measure will be advanced to the further development which the service of the public appears to us to require, as in the subject matter of the memorial.

The Postmaster-General, after asking if any one else desired to speak, said—Lord Alfred Churchill and Gentlemen,—Although I should not like off-hand to incur the responsibility of accepting some of the very ingenious numerical calculations put forward by my friend Mr. Chadwick, as to the gain to be obtained in time and other elements by a reduction in the price of telegrams, yet I can assure him, and the other members of the deputation, as well as the numerous Chambers of Commerce throughout the country, who have memorialised me on the subject, that no member of the deputation can recognise more fully or more strongly than I do, the great advantages which would be conferred on the entire community by a reduction in the price of telegrams, if it were possible, or by the adoption of any other means which would facilitate the mode of internal communication. I think it was Bentham who once remarked that of the many services which could be rendered by a Government to a country in administration, there was probably no service so great as that of facilitating modes of internal communication; and in that opinion I strongly concur. In order to remove a very prevalent misunderstanding, I wish at the outset of my remarks to state, with as much distinctness as possible, that so far as this department is concerned, there is no objection whatever to accept a reduction in the price of telegrams, if that reduction in price can be justified on considerations which I will now proceed to explain. In saying this, I am expressing the opinion of my colleagues here to-day, and of the other officials of the department. In estimating what ought to be the price charged for a telegram, I think we ought to keep steadily in view these most important principles. If the price charged for a telegram is not sufficient to make the telegraphic service commercially remunerative, then the deficiency which will undoubtedly arise must be made good out of the general taxation of the country, and the general taxpayer is fined to enable the senders of telegrams to send them at a lower rate than the market price. It seems to me that this would be just as economically indefensible as if you were to impose a tax upon the general community in order to give a grant in aid of wages to some special class of labourers; or, as if you taxed the community to give a bounty to some particular trade, with the object of causing commodities produced by that trade to be sold at a price which would be less than the cost of production. On the other hand, I wish with equal distinctness to state that, if a price is charged for a telegram which is more than sufficient to make the service commercially remunerative, then the difference between what would be the price which would make the telegram remunerative and the price which is charged, is really so much taxation imposed on telegrams: just as if the tax-gatherers stood over every sender of a telegram, and levied a tax at the time the telegram was sent. Thus, for instance, if it could be proved that eightpence would be a remunerative price for a telegram, and a shilling is charged for the telegram, eightpence is charged for the service rendered, and fourpence must be regarded as taxation imposed on telegrams. It is obvious that it is not for this department, nor it is not for me, holding the office I now hold, to express an opinion as to the way in which the taxation of the country can or should be raised, and whether, for instance, it is advisable that taxation should be imposed on the internal communications of the country. These are questions which must be determined by the Chancellor of the Exchequer and the Government generally. But, starting from the principles I have laid down, I think it is important to keep them steadily in view, because it seems to me that those principles are the ones that must chiefly determine what is the price to be paid for a telegram. Of course, we, every one of us, would like to have the price for telegrams reduced, but, after all, the question must be determined, not by our wishes, but by financial considerations; and those considerations I will endeavour to lay before you with as much brevity and distinctness as possible. The telegraph revenue, at the present time, is an improving one, and it is improving in the best sense of the word; because I find that not only are the gross receipts increasing, but the net receipts are increasing in a much more rapid ratio. I will give you the figures of the gross and net receipts for 1876, and for the last

financial year, which closed on the 31st March last, and you will see that these figures abundantly verify the very satisfactory result to which I have directed your attention. I think I can remember the figures correctly, but I have taken the precaution to give them to every gentleman of the Press present. The gross receipts from telegraphs in 1876 were £1,287,000. This revenue, including working expenses, and the amount allotted for repairs, renewals, and depreciation, was obtained at a cost of £1,090,000. In these accounts is adopted the suggestion, which I believe was brought forward by Mr. Blackwood, who now so ably discharges the duties of Secretary to the Post-office—a suggestion made by him before the Committee of 1876—that these accounts should be made out on strictly commercial principles; and bearing in mind the figures I have mentioned, that the gross receipts were £1,287,000 in 1876, and the working expenses £1,090,000, they show that in that year the profit realised was £197,000. I select the year 1876, because it was the year when a very important Select Committee of the House of Commons, presided over by Dr. Lyon Playfair, inquired into the telegraph system of the country. Passing on for four years, to the year which closed on the 31st March last, what do we find? That the gross receipts increased to no less a sum that £1,471,000, but the working expenses had not increased in anything like the same ratio, in consequence of great economies being introduced, and also in consequence of the great improvements in the modes of telegraphing to which Mr. Chadwick has referred. This largely increased revenue was obtained, comparatively speaking, at a very slight addition to the cost, for I find that the working expenses only increased from £1,090,000 to £1,117,000; and consequently the profit on the telegraph service during the last financial year, closing on the 31st March last, was £354,000; also the profit had, in four years, increased from £198,000 to £354,000; and this result becomes all the more satisfactory when, in turning to the capital account, I find that this increase of profit of nearly £160,000 was obtained with the comparatively small addition to capital account of about a million. During the present year, progress seems to be going on in increasing ratio, for comparing the receipts from telegrams for the first three months, viz., April, May, and June, of the present year, I find that the increase amounts to £80,000; and my friend, Mr. Patey, the assistant secretary for telegraph business, considers, after a very careful estimate, that the profit on the telegraph service during the current year will be no less a sum than £450,000. Consequently, we arrive at this result, that since 1876, the profit has increased from £197,000 to £450,000. Of course, no inconsiderable portion of this increase is due to the extended use of the telegraph, and to the general development of the system throughout the country; but I am bound in candour to admit—and I feel I should not be giving credit to those to whom it is fairly due if I did not admit it—after giving the subject very careful consideration, I believe no small part of this satisfactory result is due to the admirable manner in which the telegraph system has been managed by the permanent officials, to the readiness with which they have adopted suggested economies, and also to the quickness with which they have introduced every practicable scientific improvement that may have been discovered in methods of telegraphy. And now, having, I hope, clearly laid these financial results before you, I will proceed to consider what would be the best method of reducing the price of telegrams; if it is decided that there should be such a reduction. Then I will proceed to lay before you what would be the probable result of a suggested reduction in the price of telegrams. Now, out of the many suggestions that have been made for reducing the price of telegrams, there seems to me to be a particular one which has so many advantages over any other, that I shall in my remarks almost entirely confine my attention to it. You are probably aware that at the present time, with regard to all foreign telegrams, what is known as the "word-rate" is adopted. That, for instance, if you send a telegram to France, Belgium, or America, you are charged so much for each word, whether those words are in the address or in the body of the telegram; and it is a fact which is to be particularly and carefully borne in mind, that this method of charging by the word-rate has been introduced, I believe, almost entirely at the instigation and under the influence of England. It was our suggestion, and we persistently pressed it upon other countries, until they all adopted it. This being the case, if we change our present system, it seems to me that we ought to go in the direction which we have so persistently recommended to other countries. Now, the plan suggested, and the one which I would recommend, is a modification of the word-rate. I should propose, for instance, that if a halfpenny per word were charged, that the minimum charge allowed should be sixpence; consequently, a telegram of twelve words, including addresses, would be sent for sixpence, and a halfpenny would be charged for every word above the charge of sixpence. Now, if this arrangement were adopted, it would mean a charge of sixpence for twelve words including addresses, and a halfpenny per word for each word above twelve. Now it seems to me there are several advantages in adopting this particular method of charge. In the first place, it would prevent the waste of the present system. It is perfectly notorious that a great majority of telegrams which are sent contain a number or unnecessary words which go in the address, and a great number of unnecessary words also in the body of the telegram. For instance, some one sends a telegram such as this:—"From William Henry Robinson to John James Smith, Something-street, such a town, such a district, such a county," "I shall have the greatest possible pleasure in dining with you to-morrow," whereas it would do perfectly well "Robinson to Smith—Dine with you to-morrow." Consequently, I believe that if this word-rate were adopted, without the slightest degree diminishing the intelligibility of a telegram, it would in almost every instance, I may say certainly in the majority of instances, very advantageously shorten them. That is your experience, is it not, Mr. Patey?

Mr. Patey—Yes. Most messages are far too long, especially in the addresses.

The Postmaster-General—Certainly. You know that very well. Then there would be another advantage. A person would be charged more in proportion to the amount of work which the State did for him, because at the present time there is this anomaly. If a man sends a telegram containing a single word with a very short address—many are so sent—"Yes," "will come," "better," "worse," and so on; he is charged just the same as for a telegram containing eleven, twelve, or twenty words—say eleven or twelve in the address, and twenty in the body of the message. This anomaly a word-rate would remove to a very great extent. Then if the word-rate were adopted, another very glaring anomaly would be got rid of. You are, perhaps, aware that at the present time the word-rate to Belgium is 2d., to France 2½d.; a suggestion has been made, which I hope will be carried, that the word-rate to France should be 2d.—and to Germany 3d. This being the case, it is perfectly possible to telegraph to Belgium, France, or even to Germany, for the same cost, or even at lower cost, than you can send a telegram from one place to another, but a few miles apart, in London, or a short distance out to the country. Thus, with a 2d. rate to Belgium—say you have a friend in Brussels, and you want to send a telegram from one person to another in Brussels, you would only be charged tenpence, whereas, if you wanted to send such a message in London, or any other large town in England, you could not do it under a shilling.

Certainly, these are anomalies which the suggestion of a word-rate, if properly carried out, would remove, I think, to the entire satisfaction of the public. There has been another suggestion made, which I think it well to refer to, as I believe it has been discussed in public, that you should have two rates of charges; what are known as "deferred telegrams," charged at cheaper rates. For instance, those persons who go to a City telegraph office and pay a shilling for a telegram, should have it sent off at once; those persons paying sixpence, should have their telegrams sent off when all the shilling telegrams had been got rid of. So far as I am concerned, I never could sanction such a scheme as that. It seems to me to have this fatal blemish, that it would always impress the public with a sense of unfairness, and every person who did not get his telegram sent off or receive it so quickly as he expected, would think the delay was owing to a preference given to a more influential or wealthy sender. It seems to me to be a principle of cardinal importance to maintain that there should be no distinction of persons—no distinction with regard to preference, but that, as regards the first person who goes into a telegraph office, that the office should send his message first. If any departure is made from this principle, I am afraid that all confidence in the fairness of the telegraph service would be removed. Now, having stated the arguments in favour of a practical method for the reduction of charge which has been suggested, I have next to direct your attention to the very important question, viz., what could be the financial effect of adopting what I will now briefly call the sixpenny telegram, understanding by that expression a sixpenny telegram combined with the modifications I have described. Soon after I was appointed to the office I now hold, my attention was directed to the subject, and I asked Mr. Patey to prepare a careful estimate as to what would be the probable financial result of reducing the rate for inland telegrams to sixpence, with the minimum of twelve words, including addresses, and one half-penny for every word beyond twelve. Mr. Patey devoted himself to framing this estimate with great assiduity. I have examined his estimate, and I am bound to say that it has been drawn up with great skill, and, what is of equal importance, with great caution; and now, without troubling you with details, I will give you briefly the result of Mr. Patey's calculations. He estimates that, if the sixpenny rate had been adopted at the beginning of the present financial year, the increase in the business which it would have brought, and the extra staff necessary to deal with that business, would have increased our working expenses by £50,000, and the loss to revenue by diminution in receipts would be £112,000. He estimates that during the present year an additional capital for new wires, &c., and in some cases for new offices and increased office accommodation, would be £100,000. Taking this sum as capital, and suppose we paid it off in a certain period by sinking fund, we will consider that at present as an annual charge of £5,000. We therefore have this result:—£50,000 for increased working expenses, £112,000 for loss of revenue, £5,000 for interest on additional capital; total, £157,000. This is the sum which would represent the estimated cost of introducing the sixpenny word telegram during the present financial year. Now, I think it is quite possible that some who are listening to me may be disposed to doubt that the introduction of sixpenny telegrams should lead to such an immediate loss of revenue as that which I have just described. But it is important to bear in mind this, that all the greatest improvements ever introduced into the postal service of the country, have, almost without exception, caused loss to revenue in the first instance, whatever might have been the advantageous result occurring afterwards. Thus, take the greatest of all public boons, I refer to the penny post. It was at least sixteen years—some say it was thirty-three years—before the penny postage yielded as large a revenue as that which was yielded by the more expensive rates previously; and therefore, such being the case, we ought not to feel particularly disappointed that so great a reduction in the price of telegrams as that which I have suggested — whatever might be its ulterior financial consequences—should in the first instance—in the first year of its introduction—lead to a loss of £167,000. But it has been said—Well, if the loss is as much as £167,000, why do you not introduce sixpenny telegrams on a limited scale? Why do you not confine the undertaking to London, and some of the larger towns? As a metropolitan member, you may suppose that I should not look unfavourably upon any proposal for giving accommodation to the metropolis. And it is said, moreover, that London has a special claim for a sixpenny telegram, because sixpenny telegrams existed in London before the telegraph companies were purchased by the Government. Yes, sixpenny telegrams did exist in London, but what was saved with one hand, was taken away by the other; because, although there were sixpenny telegrams in London at the time to which I refer, so high a price was charged for porterage, that I believe it would be found that even with the sixpenny telegrams, telegraphing in London was dearer in those days than it is now. Moreover, the increased facilities afforded to London since the Government acquired the telegraphs are something remarkable. At the time of the transfer there were only sixty telegraph offices in London—offices were telegrams could be received. At the present time the number of telegraph offices in London is above 400, and that number is steadily increasing. So great an effect have these extended facilities had upon the amount of telegraph business that is done in London, that, whereas at the time when the telegraphs were purchased by the State, only 250,000 telegrams were sent from one part of London to another in the year, at the present time the number is no less than million and a half, and this shows an increase, consequently, of 600 per cent But when we consider what would be the financial effect of confining the reduction in the price of telegrams to London, and a few other large towns, I find that it would not, to any very important extent, diminish the loss to which I have already referred. After careful estimate, I find that it would only diminish the loss of £167,000 by about £50,000 or £60,000, and the loss would still be about £120,000 for the year. Confining the cheap telegrams, therefore, to London, and one or two large towns, instead of extending them all over the country, would only make a dif ference of some £50,000 or £60,000 a-year. It seems to me that for this small sum, it would be extremely unfortunate to depart from the most important principle of uniformity, and, for the sake of £50,000 a-year, deprive the entire country of the boon of a uniform cheap rate for telegrams. Therefore, so far as at present advised, I would rather wait a little while—for a year or two—and have the thing done completely, than have it done, as it were, in a partial and spasmodic manner. Now, I hope I am not wearying you, gentlemen, but I am going to take you back, because this is a financial question that needs financial consideration. You will remember that the estimated profit on the telegraph service was, for the present year, £450,000. It is estimated that, if the sixpenny telegram were introduced, the diminution of revenue would be £167,000. That amount, taken from £450,000, leaves £283,000, and this is the estimated profit for the present year, if the sixpenny telegram had been introduced. Having arrived at this financial result, let us proceed to consider whether such a profit as this would, or would not, be a sufficient return for the capital which has been expended. In considering the capital of the telegraph service, we come to the most troublesome part of the problem. Ought we to estimate the capital of

the telegraph service so as to include all the money wasted in a careless purchase, or ought we simply to consider as the true capital of the telegraph service what would have been the capital sufficient to acquire the telegraphs had the bargain been more judiciously carried out, or if the State had constructed a telegraph service for itself? Starting with the first supposition, including as capital all the money wasted in a careless purchase, we find the capital of the telegraph service at the present time is ten millions and a half, and consequently a profit of £283,000 would return on this capital a rate of 2½ per cent., which would be somewhat below the current rate of interest. If, however, you take a careful account of what was the amount wasted owing to the careless way in which the telegraphs were purchased—if you take this amount of waste at three and a half millions, an extremely low estimate, and write it off as a bad debt—and this is what, perhaps, might be done—you would then reduce the true capital of the telegraph service to something like seven millions, and a profit of £283,000 upon a capital of seven millions would represent a return of 3½ per cent., and this would show that, even with a sixpenny rate, the telegraphs would more than pay all expenses, and more than pay the current rate of interest upon the capital expended. I am sorry to have detained you so long, but I have thought it well to lay the case before you with as much directness and fairness as possible. I think that I have said enough to show you that the question of the reduction of price in telegrams is after all a financial one, which cannot be determined by myself or by this department, but is one which must be determined by the Chancellor of the Exchequer and the Government generally. I have done no more than lay the elements of the problem before you, and hope that they may perhaps contribute to a solution. In conclusion, I will only make this one remark, and it seems to me to be important to bear it in mind, that I cannot help thinking that the true position of the Post-office in this country is sometimes not kept sufficiently distinctly in view. It seems to me to be often forgotten that this department has two distinct functions to discharge. We have, in the first place, to supply revenue for the Chancellor of the Exchequer, and in the second place we have to supply a certain service for the country. The amount of revenue we have to raise for the Chancellor of the Exchequer is not for us to determine. That is a part of the general policy of the Government. But what we have to do is to obtain that revenue with the least inconvenience to, or perhaps I should rather say, with conferring the maximum amount of advantage upon the entire community. If it should be decided that the country is in a position to afford this sacrifice of revenue, then certainly not a word of opposition would be offered by this department. We should accept the decision, and we should endeavour, as far as possible, to make the sixpenny telegram work well—I hope as effectively as shilling telegrams have worked up to the present time. I trust that I have put the whole matter clearly before you, and thank you for the kind attention with which you have listened to my somewhat long explanation.

Rear Admiral Mayne, C.B.—I do not want to take up time further than to remark upon Mr. Patey's figures, that, taking the net profit of £197,000 for 1876 and £354,000 for 1879 shows a net increase of over £160,000, if you take the profit for the present year at £283,000, in three years hence, assuming the same rate of increase, you will have £440,000 for the increase then. If, however, you only assume increase in the proportion of £197,000 to £283,000, you would have £130,000 increase, or £413,000. But I think I may say, with considerable experience of submarine cables, the increase, if the sixpenny rate were carried out, in the number of messages, would very soon catch up, if it did not do so immediately, the revenue from the shilling rate. We are very much surprised to find how cheap rates pay over the Atlantic cable wires, where the messages do not increase so much as in England. I would merely say, with regard to what the Postmaster-General said about the penny post taking so long to pay, that people then had to be taught to make use of it, to read and write. When the penny post was first started, people could not read and write as they do now, when everybody is educated. It took a generation to teach the nation. The use of the telegraph has increased much more rapidly, and if only 2½ per cent. on the capital can be obtained now, 3½ per cent. will certainly be obtained shortly.

Mr. Edwin Chadwick—I am informed that in Switzerland, there has been adopted, in substitution of the half-franc telegram of a few words, an entire word telegram rate, and that this entire word-rate does not operate agreeably in this respect, that it puts the people to the trouble of counting up the words, and of adjusting the payment for every telegram. This is so far in contravention of Rowland Hill's principle of the uniform penny rate, which saved the constant labour of taxation. But the plan you now propose, of an uniform ten word rate, which, I presume, would be marked by a distinct space that would so far save that labour, appears to me to obviate the inconvenience I have stated as applicable to the word telegram—at least, to all but a very immaterial extent, and that it may, on the whole, be regarded as completely satisfactory.

Lord Alfred Churchill—I wish, on the part of the deputation, to return our very sincere thanks, sir, for your courtesy, and the lucid exposition of your views; and I may say that we feel our case is much stronger than it was. We hope that the time will not be far distant when the Chancellor of the Exchequer may see his way to carry out our views.

The Postmaster-General—Gentlemen, again I thank you for your attention. I am pleased to receive you, and I hope I have not detained you too long.

The proceedings then terminated.

NATIONAL INSURANCE

A lecture was delivered before the Society, on Wednesday, 14th inst., at 3 p.m., the Earl of Shaftesbury, K.G., in the chair. The subject of the lecture was:—

NATIONAL INSURANCE.

By the Rev. William Lewery Blackley, M.A.

Rector of North Waltham.

I have had much difficulty in deciding how to treat before you to-day the subject which I have ventured to take in hand, for the matter is large and the time is little; and to touch ever so faintly a proposal which undertakes to blot out that national pauperism which has been adding to its catalogue of errors for three centuries, can scarcely be expected in three short quarters of an hour, even though that space be more than twice as long as a good many people consider the best of parsons should venture to detain the most indulgent of congregations, and though the maxim be unhappily too commonly quoted, that "anything worth listening to can be said in twenty minutes."

But my embarrassment in the matter comes more especially from the consideration that, as far as a public lecture is concerned, it is generally

necessary to be always beginning this subject in setting it before the audience, and always having to meet in discussion afterwards the same elementary objections, which, so far as general informed opinion on the controversy I have started is concerned, have been thrashed out fully long ago. I hope I shall be always ready to meet objections in discussion; but as many of my hearers have carefully read the essays I have written on the subject (the National Provident League, of which our honoured chairman is President, has published the first half-dozen in a shilling form, to bring them within the reach of all men who care that much for the subject), it would be hardly fair for me to take up their time in going over once again that oft-traversed ground. I have therefore resolved to-day to treat, firstly, the subject of our English pauperism and its effects; secondly, the means at present existing for its counteraction; and thirdly, to point out very briefly the plan I suggest of national insurance, based on the just principle of making every man provide for himself against destitution, instead of making those who will pay for those who will not.

Firstly then, our English pauperism.

It is important for us to bear in mind that, in the sense in which we use the word, pauperism is a very different thing from poverty. Poverty exists in every community upon the globe, but pauperism is the exclusive, and I will add, the entirely unchallenged monopoly of England. In no other country in the world can it be said that the man who will not provide for himself shall require his neighbour to provide for him. This, in passing, settles the question of the indispensability of pauperism. For there are people who will not take the trouble to think, and put aside this question by calmly pronouncing pauperism an inevitable thing; ignoring, with insular arrogance, the fact that all the world, but England, does well without it, and that we, ourselves, have only indulged in the luxury during a brief fraction of our history. Of course, there are patriots, but not of the wisest sort, ready to reject this argument from the high British point of view, that whatever is English must be right, and to regard our unique British pauperism as a distinction, like the *parvenu* who welcomed the gout because he understood it to be aristocratic. Such men would say, of course, that the existence of our pauper system in England is an argument for introducing it all over the world, instead of seeing that its dispensability everywhere else is an argument for its extinction here. With such I need not waste more time.

But, I may be asked, why was our pauper system introduced, unless it appeared to be a good thing? And I may be told, that it was a wise measure, introduced to create general content, and to discountenance revolutionary tendencies. This assertion is only made by those who, not only suppose *post hoc* to be *propter hoc*, but go further still to confound consequence with cause. In the days when our Poor-law system was in embryo, when there really was something like strong personal government in England, neither Queen Elizabeth, nor Queen Mary, nor Henry the Eighth were concerned to build an ark against the threatened deluge of revolution, and the Poor-law was not established so much to make the nation happy, as to relieve society from the loathsome necessity of hanging helpless vagrants by the hundred. Its first purpose was merely to meet the difficulty caused by a fractional section of the community, the vagrants, but not to make all who chose claimants for relief; in a word, the hurdle was thrown down only in order to gather in a few stragglers into the fold of plenty, not as the event proved, to scatter the whole flock abroad over the downs of destitution.

That was the first purpose of the Poor-law; our present fearful pauperisation is the perversion of that purpose. I pass from this point.

Whatever its first purpose and its result, our pauper system is a fact. If it is to remain a fact, let us consider what may be its justification.

1. We shall be told that it is the best means of preventing men from dying of want; a thing very easy to say but not to prove. I do not think it will be asserted with knowledge by any man that the per-centage of deaths from starvation under ordinary conditions in England is less, in consequence of its Poor-law system, than in other civilised countries which have no such law.

2. We shall be told it is humane, that it saves men from destitution; but this humanity may be shown to be of a questionable sort. An application is made for the Humane Society's Medal on behalf of a lock-keeper who has, at ten different times, plunged into the canal and rescued ten children from drowning. "Noble fellow," cries the public, "of course he must have the medal for his humanity," but the committee would withhold the medal, and I think with good reason, if it were proved that the hero himself had thrown in every one of the children he rescued. For it would have been far more humane to have left them alone altogether. And this is really a true illustration of the alleged humanity of our pauper system, which, from its very nature, contrives to create nine-tenths of the destitution which it professes to relieve. It takes away from man the first incentive to providence, and warns him against ever bettering his condition in the world, by the constant reminder that to possess anything of his own is, *pro tanto*, to disqualify himself for claiming money aid from other men.

Nor is our system any more humane in the extent of the aid it gives, than in the principle on which it gives it. The barest and poorest existence is all it offers, an existence scarcely worth prolonging, either for the pauper himself, or for the society which supports him. The pauper's life is poisoned by a sense of failure, a want of freedom, an atmosphere of hopelessness; and the society which supports him can, on no theory whatever of population, convince itself that his existence, which must be a burden and a weakness, can ever become an advantage or a strength to itself. Between the two no love is lost, and the whole theory of humanity goes sadly out of sight.

Again, because this poor dependence upon rate-relief acts, as I have shown, as a discouragement to thrift, it acts, of necessity, as a stimulus to extravagance, with the undeniable result of making our nation as striking an example to the world of waste and prodigality as it is of economical error. Poor-rates, which were meant to remedy the consequences of waste, have, in the very nature of things, spread the disease of prodigality; they

have really been inoculating our population with the virulent small-pox of waste, instead of safe-guarding them from it by the vaccine of thrift; and we have before our eyes from day to day heart-breaking evidence that the richest nation in the universe has to show the ghastliest picture of multitudinous misery; the brilliancy of our national prosperity deepens the shadow of our national penury, and the very contrast between the two fosters a daily-growing bitterness which is the offspring of suspicion on the one hand and envy on the other.

This reference to the wealth of England brings me to another point on which stress must be laid; for the existence of our national prosperity is the plain proof that our national destitution need not exist. Why? Because it is a proof that the working men of England are able to earn enough to provide for their wants. Our working men have, in most trades, the highest wages, and in most cases, the shortest hours of labour of any others. They are welcome to it, for me; I do not begrudge it them. If they were able to earn twice the wages in half the time, without quadrupling to themselves the cost of necessaries, so much the better for them. But this is not the point I wish to press. Those who think the matter through, will, I think, agree with my assertion, that every country where the remuneration of labour is insufficient to provide for the whole life, youth, manhood, and age, not merely for the life from one day to another of man in his prime, that country must, in the course of nature, be depopulated, and at last abandoned; for life must cease in a land which cannot provide a living for its people, and as they die out it can attract no other in its place. But England, we know, increases daily in population, and, therefore, cannot be such a country. So much for the general point; now for the particular one. No matter how vehemently it be alleged that the earnings of any class of labourers in England are insufficient to provide against sickness or old age, the fact remains that many noble fellows in every class prove the contrary by their thrift and the independence they toil to secure for themselves.

Of course, I do not say that the man of sixty, who has never laid by a shilling, is necessarily able at that age to secure an independent provision, but I do say that the aggregate of that man's possible earnings from the time he commenced to work for his living, would, wisely applied, have been ample, no matter how low his wages, to have made this provision, had he chosen to set about doing it in time. Therefore, our destitution and pauperism do not arise from the inadequacy of English wages to secure the independence of English workers. A striking illustration of the truth of this position is to be found across the Channel. Wages there are lower, hours of work longer, necessaries of life just as dear as among ourselves; but there is no Poor-law, and there are no paupers there in our sense of the word; and though there may be poverty, and though charitable aid for poor persons may be, and is, organised there, the aided poverty of France can never be brought into comparison with the cultivated pauperism of England, as long as the average voluntary assistance to each recipient costs the Société de Bienfaisance less than four shillings, while the average compulsory assistance to each pauper in England costs the nation more than ten pounds in the year.

So much, then, for our British pauperism. It is founded on an unjust principle, that of making the self-denying always pay for the self-indulgent; no wonder, then, that it should cause ill-feeling and discontent. And it is founded on an unnatural principle, that of teaching men to depend on others instead of themselves, and therefore no wonder that it should produce unnatural results. And it is founded on a false system, the proof of which assertion is easily given in the fact, that if all men were so foolish as to practice that lesson of dependence which our nation teaches, there would be no one left on whom to depend, and we should all die of hunger.

So much for the badness of our system. The next question is, "Should it be changed, if possible, and in whose interests?" This we can only answer by inquiring whom the present system hurts. I maintain that it hurts every one, but in different degrees, and that its alteration, if possible, is the true interest of every member of our race.

1. It hurts the rich, who have to pay a large proportion of the cost of pauperism. And this is an unjust thing. On the other hand, however great the injustice to the rich, the injury to them is of the least. They can, just because they are rich, afford it best. The injustice of taking their money for people who have wasted their own, whether those wasteful ones have been rich or poor, though not less unfair, is much more tolerable in the case of the rich than of the poor; the proof of which statement lies in the fact that were an estate of £10,000 a year offered to any one of us to-morrow, we should not indignantly refuse it as subjecting us to the injustice of paying a considerable poor-rate. Therefore, though to levy poor-rate from the rich be an unjust thing, and all injustice ought to be removed, I for one would never have troubled my head about assailing such a monster as our pauper system if all I had in view was to relieve the rich from a burden. The persons, and of course there are some, who accuse me of mooting this matter in the interests of the wealthy, know very little of my writings, and far less of my heart. And I am bound to say that the personal knowledge I have gained of rich men who support the measure which I advocate, makes me proud for the honour of England to believe that they would be nobly willing to bear far more than their present poor-rate burden, if their doing so could be shown promotive of the real good and happiness of their fellow men. This is no piece of polite clap-trap, but my own joyful glad conviction, and to those who would basely say that rich men join us for the sake of escaping poor-rates I would answer, look at our list of names. For there you will find not the money-grubbers, not the golden youth of pleasure, not the gamblers who grasp, not the spendthrifts who waste, but the men and the women who have a hope, and a thought, and a prayer, and a heart for the poor. Read the list down as I have done, in a working man's club meeting, and hear as I have heard the welcome of many an honoured name, and the outcry, "Yes, we know him, and know he is our friend." For these are the representatives of British philanthropy, of which our chairman to-

day is the very patriarch, the men beloved and happy, who give their time, and toil, and sympathy, to their suffering fellows; the very naming of their names can satisfy the poor that this cause is advocated for the sake of what they can give, not of what they can get.

2. Passing from the rich, we come to another class, whom our pauper system hurts far more deeply—I mean the thrifty working man. The injustice of poor-rates, which is chiefly matter of sentiment in its incidence upon the rich, is matter-of-fact in its incidence upon him. The rich man, because he is rich, can spare the money; the poor thrifty man cannot, and feels keenly the spoliation. Poor-rate to the rich man may be insurance against revolution, but poor-rate levied from the thrifty working man is punishment for his providence; and, therefore, though to start an anti-pauperism crusade in the interests of the rich alone would be ridiculous; to wage it for the sake of the worthy self-denying thrifty working man should really be the duty of every true lover of justice, and of all who sympathise in the spirit of honest independence, shown under such hard conditions by so many thousands of our thrifty fellow men.

3. There is a third class whom pauperism hurts most of all. It may harass the rich, it may punish the thrifty poor, but the one can afford and the other can endure the injustice; but no words can tell the utter ruin with which it overwhelms the pauper himself. It may limit the rich man's luxury, it may retard the thrifty man's progress, but it poisons the pauper's social nature, and takes, in his case, the very manhood out of man.

The potential pauper, inexperienced, thoughtless, misled by multitudinous ill-example, trusts, in the beginning, to the system which he hates in the end, and only sees his ruin when it has struck him down. But, nevertheless, it has kept him a pauper in spirit all his life, a dependent and degraded man. For it is not the succouring of a poor, infirm, afflicted greybeard at the end of life, that we must blame, but the teaching, by his succour, of the strong, and vigorous, and young, at the beginning of life, that they shall be succoured if they choose to waste; that is the early poison that rots their very social blood; that is the hideous homœopathy-upside-down of our destructive system, which pays off one pauper by making another, and forgets that while its best effort, as a palliative, fails to cure like by like, it succeeds, as an infection, in causing like by like, and supplies an ever-growing horrible succession of social ruin, to occupy the place of the social wrecks it sweeps away; it never pays a bill without giving a fresh and larger order, which would be bad enough if measured by the money of ratepayers, but is monstrous if measured, as it must be, by the misery of rate consumers. In short, for every old pauper it relieves our system makes a young one, and may be well described in words familiar to us all, "that privily in its lurking dens doth it murder the innocent; its eyes are set against the poor."

This, then, is the class which our system hurts most, the class for whose raising, the class for whose saving, all should be zealous, the class who, from beginning to end, are the most wretched, the most hopeless, the most helpless, the class for whose sake, and in whose interest, most of all, I, if I know myself at all, have set out upon that line of labour which brings me here to-day.

I have next to touch on existing means of counteracting our mistaken system. Who do most towards this? I will tell you. The thrifty wage-earners. They hate pauperism and poor-rate more than we, for they live closer to it, and do not love its associations. In the first place, they see they have to pay poor-rates for people who are wasting in self-indulgence means as large as (or larger than) those from which they themselves lay by their savings. It is not in human nature to think this fair or right. And they see, secondly, that our system, keeping as it does all the spendthrifts at the verge of destitution, as a qualification for relief, keeps down all wages by a hungry competition, and that thus they pay a second burden; and they see, thirdly, that rate relief at best is a poor provision and a miserable substitute for comfort, liberty, and personal independence. For this reason the thrifty wage-earners make stupendous efforts to secure themselves against pauperism. Apart from what they save in actual money, they pay enormous sums of their own accord in insurances to provide them with support in time of sickness; and such exertions, considering the discouragement which our Poor-law system gives to independence, are beyond all praise. And yet multitudes of these men fail in their efforts at independence, and become paupers at the last, because the best they can purchase, even at the huge over-cost to which they are willing to go, cannot, under present conditions, secure them absolutely against the possibility of destitution in sickness or old age.

Some years ago, I was travelling in a third-class carriage in the south of England. I was alone in my compartment, while the other one became nearly quite filled up at one of the stations where we stopped, by a number of builders' men. One of these, who seemed not too sober, shortly began to utter a volley of the most horribly foul language. I called over to him in a quiet way: "Neighbour, will you be kind enough to use language a little more decent? for yours is distressing for other people to hear."

He turned round to "tackle" his interlocutor, very indignant indeed that I should venture to take him to task; and his companions seemed to prick up their ears in an amused and lively interest. "I should like to know what the whatty what business the likes of you has to find fault with the likes of me. I'm a free-born Englishman, and I'll say just what I choose."

"Well but," I rejoined, "I'm a free-born Englishman too, and I'm not bound to listen to the foul language you use, and I won't."

"Well, if you don't like my language, what business have you here? I don't see what right a gentleman has in a third-class carriage."

"If you come to rights," I rejoined, "you'll allow that if you choose to take a first-class ticket, you would have a right in a first-class carriage? You wouldn't stand my telling the guard to put you out, would you?"

"Certainly not," he replied, "I'd just like to see him try."

"Then surely, if I choose to spend my money in a third-class ticket, I have a right in a third-class carriage."

"Well, may be so, but then you must take your chance of the conversation. You're a gentleman, I suppose, and, I say again, a gentleman has no business in a third-class carriage."

A hum of applause followed this piece of logic.

"My good fellow," I said, "you have no right to call names."

"I didn't call you no names," he rejoined.

"You did," I said; "you called me a gentleman. How dared you do it?"

"Well," said he, quite taken aback, "you're a parson, I suppose?"

"Yes," I replied; "but you called me a gentleman. What do you know about me—you, who have never seen me in your life before—to have the impudence to call me such a name? But," I added, "fair is fair. You have called me a name that you can show no reason for. Now, I will call you a name, and give a reason for it. And your mates shall judge between us. And, if they say I'm wrong, I'll beg your pardon."

"All right, master," said one or two of his companions, and the rest sat watching us with pricked-up ears.

"Well," I continued, "my free-born Englishman, the name I call you is a Pauper!"

He jumped up, as if to scramble over and strike me; and his comrades began to look very furious. I jumped up, as if to meet him, with a studied alacrity, which, I rightly judged, would tend to check his ardour, and, crying out "Fair play, I'm coming over to prove my words," I sprang across into the one vacant seat of the partition, amongst them all, and faced my opponent. "My lad," I said to the man on my right, "are you in a club?" "Yes," he said, "the Foresters." "Are you?" I went on, to the man on my left. "Yes, I'm in the Amalgamated Engineers." "And you," I asked a third, "what club are you in?" "The Hand-in-Hand." The fourth and fifth were Oddfellows, and so on. As I happened to have heard and noted their conversation on their entering the carriage, and had gathered that they were all about to make payments to their clubs, except my rhetorical friend, who had mentioned having dropped off from his club two years before, I came to him last. "What club are you in?" I asked. "I'm not in any," he replied. "I suppose you've got some pounds in the bank?" The rest laughed; for they had heard (as I had heard) him asking to borrow from two or three of his companions. "Not I," he answered gruffly, "I've enough to do with all I earns." "And if you break your leg as you get out of this train to-day," I asked, "where shall you be in a week's time?" "He hesitated." "Come, my lads," I said, "Where will he be?" "In the workhouse, of course," they answered. "Then am I right or wrong?" I rejoined, "Is he a pauper or not? You are all providing yourselves against sickness, and you are independent, but he—he is depending on the rates, upon me and upon you, and he is a pauper, nothing more nor less; it is a mere toss up from hour to hour whether he has to go into the workhouse or no; and some day or other he must find his way there, unless he drops down dead or is killed. Need I beg his pardon for calling him by a wrong name?"

They agreed, as I knew they would, that I was justified in my epithet, and the little encounter gave me an opportunity of a very pleasant conversation with these worthy fellows as to their clubs. I was fuller of details of the subject then than perhaps, I am now, and warned them, as I felt, very profitably against the risk of insurance in unsound clubs. They clustered round me like bees, and began to question me very busily and anxiously about their own insurances. "Sir," says one, "I'm an Ancient Woodman; is that a good club?" "Well," I replied, "it may last for a while, but it has only 35s. a man laid by, and it's an old club; you ought to have nearer £10 a man." "Sir," said another, "I'm one of the Queer Creatures; what about my club?" It has only 42s. a man laid by," I said, "and, besides, not one of you is in a club whose rates are certified by an actuary." And so we conversed till we drew near to their destination; and as the poor fellows shook my hand (for they each did, pauper and all), and thanked me for my warnings, my heart was full of sympathy for them, as I reflected what a wonderful victory a little knowledge of their concerns had enabled me to win over what had been at first coarseness, distrust, and ill-will. But there was a Parthian dart waiting for myself. "Sir," says one poor fellow, as he shook my hand, "I'm sure we're all thankful that it *was* a gentleman in our third-class carriage that wasn't ashamed to talk to us poor fellows for our good, and you've told us a lot to make us think about; and God knows none of us wants to be a pauper. Now, can you tell a hard-working man, who wants to be independent, what club he *is* to put into, no matter what it costs, that can make him quite safe, and certain never to have to beg for parish pay, or be obliged to go into the workhouse when he is old?" "No, my poor fellow, I cannot; I wish I could," was the only answer I had to give to a question so serious; for I knew no friendly society then, and, I will go further and say, I know no friendly society now, which could give to that poor man, and to such as him, a perfect security against eventual pauperism, such as he was longing to be able to procure.

As I read these words, I dare say there may be someone in this room making a mental or material note for the discussion by-and-bye, to the effect that I have uttered a sweeping condemnation of all friendly societies, declaring that there is not one good one to be found, but that, so to speak, from Dan to Beersheba, all is barren. That is a false note; I have said nothing of the kind. It is true enough that a multitude of falsely called friendly societies are insolvent, as being based on dishonesty and swindling; that many more are insolvent, as being carried on honestly, perhaps, but ignorantly; and that a number more are insolvent, because the money contributed for sick pay has been lumped together with money contributed for other objects, and been spent and lost beyond recovery. All this may be, and indeed is, perfectly true. But the statement I have made does not touch these points for a moment. If every friendly society in England were solvent at this moment, I still know of none which can do what my poor bricklayer, and hundreds of thousands of good

fellows like himself asked for, viz., absolutely and perfectly secure a man against personal pauperism, with all its wretched prospects, its haunting shadow, and its hopeless end. I go further, and say that it is a cruel thing that the thrifty men of England cannot secure even their own independence, though they spend enough to do it twice over in efforts only too often vain.

The question is natural. Why can no societies at present, however good, secure this to a poor man? Firstly, because very few make provision for pensions in old age. Secondly, because a vast number of members of such societies are afraid to pay in for pensions in such societies, not necessarily from the fear of the society's, but of their own insolvency, and consequent loss of their whole position. Thirdly, that to make such provision under common circumstances is really too costly, for the lower class of wage-earner, at least. The result of which consideration is, that a vast majority of poor men, who call themselves independent because they are members of a friendly society, are, in general, only partially independent, and at best only precariously independent.

1. They are only partially independent, because some of them are only so far provided as to be contributing a trifle to pay for their funeral, their claim for which benefit they will have to forfeit, with all they have contributed for the object, if they become paupers, and unable to keep up the payment of their weekly contribution.

Others, provided not only for cost of funeral, but cost of sickness, are still only partially independent; knowing, as they perfectly well do, that dependence on poor-rate is with them only a question of time, since, when past work and unable to earn wages, they must go to the workhouse.

Now, if we strike off from the aggregate membership of the so-called friendly societies in England, all who are only partially insured against pauperism, and, *pro tanto*, dependent on poor-rates, we shall be amazed how very small a per-centage of the whole number, making some provision against possible necessities, remain who are making any provision whatever against pauperism in old age. Let us have no dust thrown in our eyes on this point. Many a so-called good club has had its merits flaunted before meetings of poor workmen as vastly superior to national insurance, because its managers have paid off all a paralysed member's future claims upon it with a munificent donation of £20, £30, or even of £50; as if any such sum, which might keep the sick man and family from six to fifteen months, really made him independent of poor-rates or safe from the workhouse, once that dole, which could not be saved and could not be increased, had vanished away. In a word, nothing but a weekly or monthly pension in old age can possibly secure a wage-earner from eventual pauperism; and, instead of being the universal rule, the purchase of such pension, in present friendly societies, is the rare exception. Thus, I think it will be admitted, that I have shown the present independence of our working men to be only a partial independence.

I have said also that it is precarious. And this needs very little proof. For though the society may be a solvent and honest one, which undertakes to secure a man's sick pay, it only undertakes this task on one condition, that the member keeps his payments up monthly during his lifetime. And how often, even apart from occasions where the means of doing this are lost by vice and self-indulgence, the task becomes impossible. Long-continued slackness of work, hard times, family sickness, disaster, or misfortune of one kind or another, only too frequently leave a man absolutely unable to gather together the few shillings which will pay up the arrears of his contributions, and the distress of one year compels him to relinquish the provision he may have been paying for during twenty. Gentlemen present interested in the administration of our Poor-laws know only too well what a vast proportion of fathers of families who are applicants for rate-relief have been members, at one time or other, of friendly societies of one sort or another, and have found their membership not only precarious, but utterly vain at last, either because their society has not secured to them its covenanted provision, or because they themselves have not secured to it their covenanted contribution.

I daresay my audience will accept this as sufficient evidence of the precariousness, even of the best of friendly societies. And having shown that present efforts at securing independence are ineffectual, because such efforts generally aim at only partial independence, and because such efforts universally are precarious, I offer a challenge which I shall be very glad if any gentleman present, who thinks of sharing in our discussion by-and-bye will take up, and I ask to be told the name, and shown the rules of any existing friendly society in England, which can undertake to give complete and perfect security against pauperism to any independent-minded working man, who, like the poor bricklayer I have been speaking of, is anxious to obtain it.

Till we have the name, the rules, and the actuarially certified tables of such a society put into our hands, I will be bold to say that no society exists at the present moment, whereby a thrifty man can make himself absolutely secure from pauperism. Why do I lay so much stress upon this? I will tell you. Because, if I do not, some one may get up presently, when I have said my say, and assure you that the proposition and advocacy on my part of national insurance as a means of giving the thrifty man such a blessed and perfect security against pauperism is quite a work of supererogation, inasmuch as the existence of present friendly societies, which do the work already, makes it unnecessary; and I wish to prevent this being said by insisting, with all my force, that not only do present societies not do the work, but that, under present conditions, the work is impossible for them, with the best will, to accomplish. I speak as a member myself of an important friendly society, as founder and president of one of its branches, as one who, all my clerical life through, have persistently and urgently pressed upon men the duty and the dignity of joining a friendly society; I speak in admiration of all the friendly societies have done and are doing, and in hearty sympathy for the difficulties which lie in poor men's way who try to raise themselves. I readily grant that good friendly societies are good things, and that, however incomplete their operations, such operations are better than none. I will

go perhaps further than any one else in this direction, and call it at least fairly debateable, whether in the case of a man who has paid into a friendly society for 50 years, and found it fail him in the end, his aggregate of happiness and self-respect have not been vastly greater than the pauper by his side in the workhouse, who has been depending on beggary all his life long without ever laying by a shilling; but, conceding all this, and granting that, in some possible ways, there have lately been some possible improvements introduced into some exceptional friendly societies, I still contend that when national insurance undertakes what they could never undertake—namely, to secure all men against pauperism—there is no more sense in opposing it on behalf of any or all the friendly societies, than there would have been in opposing railways because wheelbarrows were already in existence, and more especially because a few wheelbarrows were constructed on more scientific principles than the rest.

I trust that this may be sufficient to keep out of our discussion every one who, up to the present time, has supported or said that even the best friendly societies are generally doing, or professing to do, anything at all commensurate with what national insurance would do in keeping men above the possibility of pauperism. Their alleged success in saving some men from some pauperism, can no more be advanced as a reason against saving all men from all pauperism, than the existence of a railway between London and Watford should be urged as a good argument against making a railway from London to Liverpool.

So much for the argument that friendly societies are doing the work of national insurance, and, therefore, that the latter is unnecessary.

Now, there is quite another objection to meet. That national insurance would compete injuriously with present friendly societies; and, therefore, should not be permitted.

I answer, firstly, that if it did it would be right. For does not every friendly society now compete with every other friendly society? And must not each one try to present features of special advantage in order to raise its head above its fellows? Why, if a good society be better than a bad one, and should, therefore, be recommended, shall the best conceivable be forbidden to exist lest it should be supposed to interfere with others demonstrably less useful than itself?

And, secondly, I go on to say that national insurance cannot injuriously affect a friendly society formed on proper principles, and to which each member has contributed the proper cost of the benefits he is supposed to have assured. A club that has been speculating on a perennial supply of young insurers to make up the deficiency of payment by old ones, has never been formed on proper principles, and is bound to die out of itself, whether national insurance be introduced a few years hence or no.

Such are some of the unsurmountable difficulties which beset present voluntary efforts, however self-denying and noble, in the way of independence.

Let me add, if these were all perfectly successful, instead of proving, in too many cases, altogether ineffective, they are efforts made by the thrifty classes only; and no supplying these with perfection of security would necessarily unteach in time the practical lesson of dependence and improvidence which our Poor-law system has been teaching to our thriftless poor.

Then we must alter the system. And, I think, every one will agree that this should be done, if possible. But some, of course, rejoin, "What! We have had it for 300 years; it can't be altered now." I reply that that is the very reason. It has had 300 years to grow worse on, and, as each day it is growing more destructive, its alteration becomes, by the very antiquity of the abuse, the more necessary. Should we then abolish it? Shall we cut off to-morrow, from every one not now in a workhouse, every claim to relief? Well, this has been suggested, and I believe myself that were it done, even the potential paupers now would not be left to starve, and the nation for all time to come would be the better for its abolition. This may be true in theory, but I, for one, should be very sorry to advocate its practice. If I did, the two or three who possibly snarl at me now for being sanguine, would have a right to scoff at me then for being silly. No! we cannot abolish our Poor-law. That is altogether a mistaken line. But if we can supersede the Poor-law, as I believe we can, by a system of national insurance, which, taking every unit of the nation in youth, shall compel him, as nature meant him, to make provision for himself against want in sickness and old age; and if, instead of teaching him a wrong reliance on the spoliation of his fellow men, it be possible to take away from every one the possibility of pauperism, by making each man too rich to claim a farthing from the rates; if, I say, this thing be be possible, surely my hearers will admit that the change it would work would be of such benefit to every class in our nation, as should entitle the proposal to their study, its advocates to their sympathy, and its advancement to their aid.

This then, in the fewest words I can put it, is my position in advocating national insurance. Every man ought to provide for himself. The young, while single and earning good wages, can do this with ease. It is more just that the law should compel them to do this for themselves, than that it should compel others (as at present) to do it for them. And this is the plan itself—that every one, rich and poor alike, should be compelled, by the time they reach the age of twenty-one, to complete a contribution in a national friendly society, sufficient to secure them against destitution in sickness or old age.

The contributions of the rich, who (unless reduced to the necessity of wage-earning) would never draw from the fund, aiding the contributions of the poor who would, the cost to each person of such a self-made provision would not, probably, exceed a single sum of £10.

The fund would be collected and distributed through the Post-office; the law requiring employers to deduct and pay in a fixed proportion of their young workmen's wages, the State running no risk whatever, as the requisite money would all be paid in advance, and the members, on the other hand, being secured from failure by receiving a national guarantee for their investment. The money to be paid either in one sum, or by instalments, between the ages of 17 and 21.

The machinery of the Poor-law would remain, while if everyone were provided against sickness

and infirmity, the greatest part of our poor-rates would vanish altogether. So that, while the rich would save the greatest part of the present enormous impost, the really thrifty working men could secure their independence vastly more cheaply, and infinitely more safely, than at present; and, in addition, the huge class of the thriftless, who in the present course of things must become paupers, would in the outset of life have made their own inalienable provision, which would leave them, in spite of themselves, independent of rate relief for ever. Such a measure, in course of time, would, with very few exceptions, abolish pauperism, almost entirely extinguish poor-rates, and give to every unit of our nation an independent provision made with his own money.

So much, then, for my lecture proper. I have touched only a very few points of a subject in which there are very many salient ones. The desire to turn every moment of our short time here to profit, as a practical illustration of thrift, has forced on me the great self-denial involved in my silence as to the history of the controversy I have ventured to awaken, and I have refrained from singing my natural song of exultation at the rapid and growing progress which these views have made. I only refer to this, which has been a real self-denial on my part, in order to lay claim, on the part of those who follow me, to a little self-denial on theirs. I cannot limit, of course, the scope of their criticisms, and, provided I have fair time in which to answer them, I would not if I could. On the contrary, I welcome these with all my heart, as contributions to the furtherance of a cause that is good. And, in fact, the stronger the friction, the greater is the light. But, considering the degree to which many whom I see round me to-day have studied the question already, and how familiar its most obvious features are to them, I think I may be allowed to suggest, not as limiting the scope of our discussion, but as widening its general utility, that those who take a public part in our debate should have given so much of preliminary consideration to the subject before occupying our limited time, as to have read through the little shilling book of essays on "National Insurance," which have been before the public for the last three months.

And this is my reason for the suggestion. Shortly after my first essay on "National Insurance" appeared in the *Nineteenth Century*, the question of holding a Conference was mooted, after a fortnight's previous notice, in a meeting of an important London society. The chairman of that meeting opposed the holding of such a Conference, and, happening a month or two later to make his acquaintance, and at the same time that of three other members of the society in question, we naturally began to discuss the subject. According to my general experience, I found so many of the objections these gentlemen laid most stress upon to be not chargeable at all against the proposal made by me, that I interrupted the discussion by asking them, one by one, whether they had read the article itself which they considered so extravagant. As I expected, *not one of them had.*

Now, I really hope to-day that we may be favoured with some new objections, if only to give a little refreshment to the minds of those who, so far, have taken the honest trouble of following the literary treatment of this subject, and who, like myself, are growing naturally a little sick of always having to drum out the same stereotyped answers to the same old objections. For, though a good carpenter learns to hit the right nail on the head, and will not begrudge the pains necessary to drive it thoroughly home; yet, once driven home, to have to hammer it a hundred times over will naturally seem to him a cruel waste of labour.

DISCUSSION.

The following letters from Prof. Leone Levi and the Hon. Richard C. Grosvenor were read by the Secretary:

5, Crown-office-row, Temple, 14th July, 1880.

Dear Sir,—I very much regret it is not in my power to attend the meeting for the discussion of Mr. Blackley's scheme for national insurance. Any effort to promote thrift and self-dependence deserves the support and commendation of the entire community. There is, however, a special character in Mr. Blackley's scheme, which, I fear, puts it beyond the verge of practicability. Compulsion is the very essence of his plan of national insurance. But can we make men frugal, or sober, or honest by law? It is aiming at an impossibility. Mr. Blackley proposes to tax every person—I do not know whether men and women alike, or men only—of the ages between 17 to 21, to the extent of £10, in order to make a fund to meet the contingency of poverty. According to the last census, there were in England and Wales about 1,000,000 men and 1,000,000 women of the ages between 17 and 21, increasing, probably, at the rate of one to one and a quarter per cent. per annum. But how many of these would be able to contribute the required £10? A large number, at that age, are still at school or college. A still greater are in their apprenticeship, some paying a premium for it; many more are earning little or nothing; many too idle to work; and many are struggling to save a few shillings at a time as the nucleus of a little business. Of those at work, moreover, how many have fixed employment? Mr. Blackley proposes that the employers should deduct the contribution from their wages, but masters could never become responsible for their men's contribution to the insurance fund, nor would they have the right to deduct a farthing from the wages, unless with the full concurrence of their men. A wage tax would be as unpopular with masters as with men.

I have no time to make the necessary calculations to ascertain what number of contributors could safely be calculated upon, and how much would be required from each to cover the requirement of in-door and out-door relief in all cases of necessity from want of work, sickness, old age, &c. But the amount now expended by the Poor-law Board, or rather the Local Government Board, is not less than about £7,500,000 a year in actual relief, and I scarcely see how is it possible that so limited a sum as £10 by each individual of the ages mentioned, with the exceptions suggested, can suffice to meet anything like that expenditure. To my mind, the Government could never abandon the right of levying the necessary amount, year by year, by rates, trusting on a method of contribution which would never be enforced, and which, in its results, might prove very disappointing. Mr. Blackley, in fact, does not propose to do away with the Poor-law. Therefore the plan would be supplemental to what exists, an extra tax to be borne for a number of years, at the very inception of our business life.

Mr. Blackley would make the rich pay for the insurance as well as the poor. But to make the son of a wealthy landowner or millionaire pay a premium of insurance against the chance of his becoming a pauper,

would be regarded as only a new method of taking money out of his pocket. I regret Mr. Blackley's paper does not give, in detail, the *modus operandi* of his scheme. I do not know whether he proposes the same remedies for enforcing the contribution from either class, as in ordinary taxes.

Allowing all the faults of the present system, the evil of pauperism, and the need of something better, in all of which I heartily sympathise, still the question before us is simply this—can the State continue to provide, at all hazards, for the poor, the sick, the old, the widow, and the helpless infant, out of a fund so novel and so uncertain? I fear it would not be possible to do so. And would not pauperism practically remain as it is, so long as the fund depends on its being supplied in any part by the rich, who would never require to draw from it.

In some sense we have a system of national insurance now in operation. The £30,000,000 a year of taxes paid for the maintenance of the military and naval forces, and for the Courts of Justice and police force, is the premium paid for insurance against external and internal dangers. The amount paid in poor-rate is the premium of insurance against the danger of starvation. I do not see wherein Mr. Blackley's scheme differs from the present poor-rate system. Insurance is a contract of indemnity, whereby one party, in consideration of a specified payment, called a premium, undertakes to guarantee another the risk of loss. It is, in all cases, a personal contract, most provident, if contracted on the strictly business basis that each individual premium shall cover his chances of loss. Mr. Blackley's scheme differs in this, that the rich, who have no chance of loss, are made to contribute for the poor, who have.

The savings bank, the Government insurance, and the friendly societies, are individual insurers for the wise, the prudent, and the careful among us all. Let us strive to increase the number of these, and we shall do better than by any scheme with the element of compulsion as its fulcrum, and Government action as its medium.—I remain, dear sir, yours faithfully,

H. T. Wood, Esq. ——— Leone Levi.

35, Park-street, W., July 14, 1880.

Dear Sir,—As treasurer of the National Providence League, I should have been most glad to have taken part in the discussion on Mr. Blackley's lecture to-day, but I am, unluckily, prevented from so doing by another engagement. It seems to me that Mr. Blackley's scheme requires careful thought and discussion at present on two points only, firstly, as to its economic aspect, and secondly, as to what is likely to be its effect on the character of the community of this country. As to its economic aspect, I think it important that people should consider carefully the opinion of all writers on political economy, *i.e.*, that a tax upon wages cannot come out of wages, but must come from the wage-payers, *i.e.*, the employers of labour, in the first instance, and eventually from the whole body of consumers. I do not think, personally, that this is any real objection to the scheme, because, in my opinion, the adoption of it would be but a slight recognition of the dignity and rights of labour; but I can easily imagine that many persons, who were attracted by the just outlines of the idea, may be alarmed when they understand its full proportions. As to the second point, namely, the social aspect of this scheme, *i.e.*, its effect on our national life, I have but little to say, because the matter seems to me to be one of speculation merely, and it seems to me, that it is the business of those who object to the scheme on sociological grounds, to point out clearly, and with some approach to defineteness, the evils which they expect to grow out of it; at the same time, I hope it will not be forgotten that a very considerable section of Englishmen will object to the scheme on the ground of fear of over legislation, quite, as I think, without reason. I should have been glad to have touched upon other points connected with the scheme, had I been able to be present, but it is hardly to be done within the limits of a letter, and indeed I fear that some apology is already due to the meeting for the length of this one; I shall, therefore, now bring it to a close by subscribing myself, dear sir, yours faithfully.

Richard C. Grosvenor.

A letter was also read from Mr. R. D. Mocatta, expressing his regret that he was unable to attend the meeting.

Mr. G. C. T. Bartley said the subject of thrift was to be congratulated on having a man like Mr. Blackley, who was so enthusiastic, in its support, and although he should have to offer a few words of criticism, and once more to hammer at some of the old nails, which Mr. Blackley thought he had accounted for so effectually, it must not be supposed that what he said was offered in any factious spirit. He had been working at this subject for many years, and he objected to this scheme not only because he thought there were inherent difficulties in it, which would prevent it being carried out, but also because it would retard the inculcation of the habit of thrift throughout life, which was, in his opinion, one of the only ways of really permanently improving the condition of the people. Some objections had been already raised in the matter by Professor Levi, and there were others which seemed to him very important. He felt that this compulsory payment did not in any way insure a man becoming thrifty, and that after all increased thrift must be the real basis of social improvement. Perhaps, however, it might be said that if the scheme would do all that Mr. Blackley said it would, it was a matter of small moment whether people were thrifty or not. He also agreed with Professor Levi that this was simply another form of Poor-law; a form by which the employers of the community would have to pay, not to maintain the old, but to pay for the young, what was necessary to provide for their old age. The two main objections he wished to raise were with regard to sick pay, and to the mode of collection. The scheme divides itself into two chief heads, one was that every person, after paying this sum of £10, or whatever sum it might be, was secured in perpetuity so much a week whenever he was ill during life; he was to have it absolutely by right from what was practically Imperial sources, and to claim it as his own money. Whenever he was ill he could go and get it without any questions being asked, except proving that he was ill under certain forms of medical certificate, &c. This in no way differed essentially from the principle in which a friendly society was carried out. He, like Mr. Blackley, had been a member of the leading societies, and he thought that no one should discuss these matters unless they really knew the working of these societies. He had had the pleasure of attending many of their meetings, and one of the greatest difficulties they had to contend with was to prevent unreasonable or excessive claims in sickness; one of the constant difficulties of these societies was to prevent men getting sick pay when they ought not to do so, or remaining on the list too long, and in spite of all their precautions, there was a great deal of excessive claims. In order to reduce this to a minimum they separated completely the fund which was to provide for old age and death from that which provided for sickness. The burial fund was one which covered the whole friendly society, but the fund out of which sickness was paid came out of the small court or lodge, consisting of so many members, who were all more or less known to one another, and living in the same neighbourhood. Before any man got a payment, in spite of the doctor's certificate, he had to be visited by two members; if they found him out at hours which were not allowed, he was put off the list, and every member of the court was, so to speak, an agent to prevent fraud or excessive demands from taking place. Yet, in spite of all these precautions, frauds did occur. But, when you turn to Mr. Blackley's scheme, all these safeguards were done away with. No doubt they would

have to claim through a doctor, but they knew that a doctor's certificate alone could not be sufficient. As a matter of fact, friendly societies were not satisfied with it. When a claimant had that certificate, there was no individual member who was interested in looking after him; he would be simply going to get so many shillings out of the State Fund, and no one was interested to reduce it. They all knew that when persons were claiming from an Imperial fund, which this practically amounted to, they were not particular in the way they did it. He had been over 20 years in a Government department, which had a great deal to do with spending money, and they found even there that the conscience of people in drawing on an Imperial fund was not so tender as it might be, or even as particular as it was with regard to a local rate. When you had hundreds and millions of people who had a pull on this fund for sickness on all occasions, not only would £10 be insufficient, but he believed that no number of £10 would do it. Not only so, but this right to claim in perpetuity on one small fixed payment would undermine the whole responsibility of the community; they would claim out of the fund because they had paid a few pounds in, thinking they were secured for ever, as indeed they were told would be the case. His second great objection was the practical impossibility of collecting this money properly. It was very easy to say that it was to be collected from every person from the age of 17 to 21, but persons at those ages were not resident householders, and would be very difficult to catch. People from whom you had to get a rate were proverbially difficult to catch, even when they were householders; and again, when you had them, he did not know how you were to identify them. Possibly, Mr. Blackley might suggest some scheme of putting a brand on their right hands, or the letter "P," or perhaps in compliment to Mr. Blackley they might put a "B," but short of doing something of that sort, he did not see how you could prevent those who should pay from evading payment. Again, great numbers of persons would find it impossible to pay. How could hundreds of the working classes put by a shilling a week; you could not bring them before the magistrate to compel them. It might be suggested that they should not be allowed to marry until they had put by £10; that might be suggested, but it would be difficult even for Mr. Blackley to carry out. The collection would be difficult, and he thought it would simply come to this, that employers would have to pay this money, the same as they did the poor-rate. On the whole, therefore, he thought the better plan was to endeavour to inculcate habits of thrift by means of education, extension of the Post-office Savings Banks, penny banks—though this, perhaps, might be said to be his own hobby—and the diffusing of literature bearing upon the subject, for he did not believe that this system would ever take away the block of pauperism from this country.

Mr. Cornelius Walford said the paper had been opened with consummate ability, and they were now asked to discuss the question upon its principle rather than on the details, which, perhaps, they should never agree upon. Those who now entertained the notion of national insurance, naturally had their minds carried back to the many foolish schemes which prevailed at the close of the last century and the beginning of the present, which were so utopian, so numerous, and so impossible, that they, for the moment, apparently blotted out, almost at once, and for ever, the chance of having a fair and rational discussion on national insurance. He was glad to see that Mr. Blackley had put his scheme on a more rational footing, and still more glad to see that in his paper there was an absence of that intolerance which too often characterised gentlemen of the cloth. He had tried to be practical, and it was essentially a practical question. Some of the points he should have referred to had been anticipated by Mr. Bartley, but there were one or two that struck him as presenting immense difficulty. In the first place, the contributions were to come in from the ages of 17 to 21, but it was the universal experience of friendly societies that from 18 to 21 or 23 was an extremely dangerous age as to the number of claims which arose from sickness and death. This point appeared to have been entirely overlooked. It might be met by saying that, although you contributed at those ages, your claim shall be deferred; but that almost amounted to injustice. The next point that arose was one that had been referred to by the preceding speaker, the great difficulty of preventing fraud. He entirely agreed with him that the medical certificate was not only of no use, but in many cases absolutely misleading, and a greater fraud than the man himself was attempting to perpetuate. He spoke after 30 years' experience, having to deal with them almost every day, and he was sorry to say that in the large proportion of cases a medical certificate was utterly worthless for the protection of the association it assumed to guide. This might be remedied perhaps by reason of the multitude of persons interested—everybody in a scheme of this sort being interested in preventing the fraud of his neighbour; and he admitted that by reason of the generality of the scheme there would be some hope of avoiding frauds which would otherwise be inevitable. But going a little further, however good a thing was, you had to consider whether it could be accomplished. He had looked in vain to see any chance of getting such a scheme accomplished, even assuming it were desirable to do so. It would be for the good of the people in many respects, for it had an element which had never been introduced before, that of making people pay for themselves, instead of making one person contribute for another; of course there was the objection that the rich contributed to the poor, but they did that under the present system. The Poor-law originated at a very critical time of our history, when some such law was absolutely necessary. The church had been despoiled, rightly or wrongly, of her treasures; the church, which was the great nursery of pauperism, was swept away; the multitude of loafing beggars whom the church had nursed and matured would have starved—he for one thought it would be a good thing if many of them had; but the Government of the time thought it wise to introduce a system of Poor-law, which had built up in three centuries a nation of paupers, which had degraded mankind, and done all that it ought not to have done. In America there was no Poor-law, and there—for he was well acquainted with the country—he saw no poor. Every man there must work or starve, and he had travelled through most States of that Union and found men working and not starving. If you could abolish the Poor-law you would do a good thing, except for one fact, that the Poor-law had built up millions of paupers who would starve if you abolished it, and, therefore, you could not in reality abolish the system which had created these people. You must nurse the Poor-law alongside of national insurance, and, therefore, must contribute, not only for the one, but for the other, and keep the bad scheme going pending the realisation of the good one. But, again, how were you going to get this national insurance? You must begin by having national statistics, and was there any hope in this enlightened age, with a Government which set itself up to be the most enlightened Government which ever existed, that such a thing would be done? What took place only the day before yesterday in the House of Lords? A suggestion had been made by some of the learned societies that a record of persons sick on the day of the Census should be taken, and Viscount Enfield said as to the sickness it would be of little value to know two years after the date who were or who were not in good health on a certain day. Was there ever in the history of human folly a statement so utterly nonsensical for a statesman to utter as that? If they knew how many sick persons existed in this country on

any one day, and the period of life, they could tell how many there were every day of the year, or, at all events, in the corresponding seasons, and would be able as actuaries to calculate the exact per-centage of sick persons, and to know whether the contributions proposed by the rev. lecturer were sufficient or not. It was precisely from the want of this information, which that statesman did not see the force of, that no national scheme of insurance could be introduced. When he read such a thing of that sort he felt disgraced that he was an Englishman. It would be carried out to the other side of the Atlantic, and would be held up there as a sample of the political wisdom existing in this country; and when the rev. gentleman's lecture went forth there as an effort to alleviate mankind, alongside of it would be printed, and should be printed, the statement that it was no use to know how many persons were disabled or unable to work on any given day of the year. Until we had more enlightened statesmanship than that, and also a more enlightened community, it was idle to talk of national insurance. He believed that national insurance had something in it, and that the difficulty of detail could be got over, but he believed there was no hope for a country legislated for as this country was. Therefore, in making people think over the matter, and realise the difficulties we were in, Mr. Blackley was simply giving them a pleasant dream, which neither this generation nor the next would realise, not because it was not good, but because it was too good for the comprehension of those who governed us.

The Rev. C. W. Ensell said he came over from France the previous day, and could bear testimony to the lecturer's statement, that there was fearful pauperism in England, and only poverty in France. For more than five years, in times past, he had been chaplain to a workhouse, and he could also bear testimony to the statement that to put the poor into a poor-house at the end of 30 years' hard work was indeed cruelty. He had also worked as a curate in many towns and country parishes, and could bear witness to the statement that the poor neither could nor would provide for the sickness of old age. He did not, however, wish to speak on the details of this plan, but asked permission to speak on another. He came over for the express purpose of bringing before the notice of the present Government, or failing that of the late Government, a scheme which he put forward nine years ago for the purpose of securing pensions to all persons earning less than £300 per annum. He would advise introduction of a wages-rate, collected by means of labour stamps of various values, and at the end of a certain number of years a pension should be given to those who paid that rate. This scheme had been already published, and he was very thankful he came to that meeting by accident, because he hoped he should find some friends in the room, who would enable him to get it published in London. He would make it a compulsory system if possible, but if not, voluntary for the first 20 years.

The Chairman said the meeting was assembled to discuss Mr. Blackley's scheme, and he did not think it would be in order to go into any other.

Mr. Hale thought the paper was one of great importance, but the difficulties in the way of carrying it out seemed almost insuperable. He could not agree with the statements of the lecturer that it was not of necessity that agricultural labourers required assistance in their old age. The Scripture said the poor would never cease out of the land, and that he that gave to the poor lent to the Lord. Many people were poor through no fault of their own, and when it was proposed to provide for the whole of after life, by payments made in four years, from 17 to 21, he thought some kind of statistics should have been given to show how it could be done.

Mrs. Heatherley said she had thought of something of this sort a good many years ago, but had come to the same conclusion as Mr. Bartley had, that it was not a possible scheme. She came to the conclusion from the experience in connection with a benevolent society for women. She did not know whether women were intended to partake in this scheme, but it certainly would not be complete unless they did. They all knew what a critical position a young woman was placed in who had to gain a living by her own exertions; many of them earn wages from 9s. to 15s. a week, out of which they had to pay as much as 4s. a week for rent, and she did not see how it would be possible to contribute the £10 required out of such small earnings. One injurious part of the scheme appeared to be this, that if people were told that having paid from 17 to 21, they were provided for for life, they were very likely, having been compelled to save up to 21, to turn restive, and spend for the rest of their days. That sort of thing occurred in the upper classes, for they knew very well that many young men that came into a good fortune at 21, squandered it after that age. She should be quite prepared to subscribe to a society for mutual insurance upon a much larger scale than the one to which she belonged, and should be prepared to pay very much more than £10. The society to which she belonged admitted members above the working classes, but they felt the danger of the richer people being mixed up with the poorer, as they wished particularly to steer clear of charity. Therefore, supposing she were ill, she would have to get a certificate from a doctor in order to get the benefit, which was a very small one, and it would be more trouble than it would be worth; but it was quite necessary to have this rule, in order to prevent the society degenerating into a charity. She could quite endorse what Mr. Bartley had said about the cheating which sometimes took place. Women did not save as much as men, not because they were not as saving, but because they ran the risk of losing their savings when they had made them. With regard to the census, it struck her there would be a great many more people put down as ill in one class of society, and of one sex, than another. When these benefit societies, of which Mrs. Patterson was the promoter, were started, it was thought there would be great risk, and that women would be more often ill than men; but as far as their experience went, they found women kept up much longer in proportion. Ladies, however, were very apt to give way when they could lay up and take care of themselves. Therefore they did not propose giving sick pay to people, unless they were really so ill as to require a doctor if they were in a better position of life. One great difficulty in getting people to save was that they could save so little. The society she had referred to began with a 2s. entrance fee, and 3d. a week, but it had to be broken up, and began again with 1s. entrance fee, and a payment of 2d. a week. She thought the worst evils of pauperism would be removed by abolishing the system of out-door relief, for the money very often really did not go to the parties who received it, but passed through their hands to others.

Mr. Green said he took a great interest in the question of thrift; and one remark that he had intended to make, he had been anticipated in by the last speaker, namely, that having compelled people to pay up a certain amount, it might, in the end, frustrate thrift rather than promote it. When he first looked into and thought over this scheme—and he heard of it first two years ago—he was a little taken with the comprehensiveness of it, and thought it might be made to do a great deal of good; but the more he looked into it, the more he saw insuperable difficulties in carrying it out. Everyone who wished for the improvement of the working classes of this country must hold that the aim of the author was admirable, but the only difficulty was as to being able to carry it out. He must say he agreed with many of the objections which had been taken. The English did not like the word "compulsion," and the

working classes especially objected to it, although they had had it with regard to schools and education; but he did not think there would be any possibility of applying it to such a scheme. He thought the best means of promoting thrift was, by gradually educating people up to it, by the diffusion of literature, by penny banks, provident dispensaries, and so on. By that means they would inculcate the spirit of thrift which Mr. Blackley appeared to be so consistently endeavouring to promote.

Mr. M. Knowles said it appeared to him that this scheme was founded on a totally wrong assumption in more than one way. It assumed that the Poor-law was answerable for the present pauperism, but that was an assumption without foundation, and which could not be proved. On the other hand, he believed the present excessive rate of pauperism, as appeared by the charges, was due entirely to the altered conditions under which paupers were put. On that point he was, perhaps, a better judge than any man in the room, for in his early life he spent two years, from 1838 to 1840, in a workhouse. He had a perfect recollection of what workhouses were then, and knew what they were now, and he had no hesitation in saying that, mainly owing to the efforts of the noble lord in the chair, the cost of pauperism was three times as much in the workhouses as it was then. If that were taken into consideration, you would find the eight millions of money spent was, after all, spent in a way that very few Englishmen would be disposed to cut down. He would most willingly pay twice the rates he did rather than see the children in the workhouse have one single comfort the less. But the scheme also proceeded on a further wrong basis, it assumed that all pauperism might be prevented; but this was not so. Nine-tenths of the pauperism in this country was of a kind not preventable; it arose, as in his own case, from the deaths of the bread-winners of the family, from sickness amongst children, and a thousand other things of that kind which it was impossible to touch by any scheme of this sort. He would venture to say, from his own experience, that to make a levy on all between 16 or 17 and 21 amongst the working classes was as utterly impossible as it was to ask them to fly to the moon. He had been for years a large employer of labour, and he knew the difficulty of getting money in this way; it was quite impossible. Any attempt to levy a rate on wages in the workshop would not simply be answered by pulling down the Hyde-park railings, but it would be the Chartist riots over again, and it would be utterly impossible to keep the country in order. If the gentleman who had read the paper would turn his attention to how far it was possible to do what he proposed to do, he would see, if he selected a small district and tried to put it in force, that it was utterly impossible. On the other hand, it was clear we might have a good deal less pauperism than we had now. He would go to a little village near Clitheroe, where a co-worker of the noble Chairman in his great efforts for improving the condition of factory people in 1842 and 1843, Mr. Thomas Garnet, hit on a scheme which he had carried out for 50 years. In a population of over 2,000, they had not for 50 years a single pauper; they had not had a poor-rate or a policeman, and had even dispensed with the much despised doctor. He had found constant employment, and scarcity of work had never been known; it was surely worth the while of persons who took up some such scheme to inquire how this was accomplished. There had been no such thing as compulsion. He had simply appealed to the sympathies of the workmen, to their thrift, providence, and temperance, and a voluntary appeal of that sort had been answered. If a child happens to lose both its parents it was assisted, and put in a position very much better off than it would have been in even with its parents; at 14 it could be bound apprentice, and at 21 a small fund was found to start in business with. If they could apply some such scheme to the whole nation there would be no necessity for such a plan as was now brought forward.

The Rev. Mr. Blackley, in reply, said he felt very much in the position of a bung on the surface of a pond, which people had been throwing stones at; stones had gone down, but the bung had not gone down, and he did not think the stones would send it down. He would take the different objections which had been raised. The greatest was that of Mr. Walford, who said the nation was not yet wise enough, and he accepted that most cordially; but he did not see at all that, because the nation was not wise enough to-day, it might not be wise enough to-morrow; and, so far as that, he considered it a positive encouragement. With regard to Prof. Leone Levi's letter, the main objection was to a thing which he had never advocated at all. Mr. Levi said this would be making people thrifty by law, which was not possible. Now, in the course of this question, he had never spoken of undertaking anything so ridiculous or absurd. He did not attempt to make people thrifty. He thought it a very good thing to make people thrifty, but he could only proceed to make people provident. What he said was—they could make people provided for. A man might be provided for without being a naturally provident man; and, if it was secured in such a way that he could not lose it, he had the advantage of the provision although he had not the character of providence. Another objection was to the master's deducting from wages; but that was a thing very much misunderstood. Another gentleman said there would be a revolution if it were attempted, and that it was quite out of the question for masters in the workshops to make this deduction. But, if the law made it necessary for every employer of every sort of labour, in engaging that labour, to be liable for a certain sum, any person who required employment would come with that clear understanding. The employer would say, "The law compels me to lay so much by; if your wages are 15s., I must pay you 14s., and pay the Post-office 1s." And then the man could not say it was the tyrrany of the master. If he did not choose that that master should do it, and went to another employer, he would be met with the same thing, and there would be no escape from it. But there was another point; it was said the master would not take the trouble of making the deductions. The fact was, a great many public offices made deductions—he believed it was done in the Post-office, it was certainly done in the old East Indian Company; each person had a certain sum deducted and put by for the pension fund. There was scarcely any large establishment where the thing was not done. He would mention rather a startling and illustrative story on this question. Some time ago he was in company with the two Messrs. Palmer, of Reading, of the great biscuit factory, both of whom were much in favour of this scheme. In discussing the matter, Mr. William Palmer said this would be a great difficulty, that in an establishment like his it would take two clerks to make the deductions from the wages and pay the men. He thereupon said to him, "Is it possible, Mr. Palmer, that in an establishment like yours, which employs thousands of workmen, you do not compel the people to be in a Friendly society." He burst out laughing, and acknowledged at once that they did. As a fact, there would be no difficulty at all about it, the employer would be liable, and if he chose to pay any person the full amount of his wages to save himself trouble, that person when he went away might County-court the employer, and make him pay in the money to the Post-office, if he could prove he had not done so. Mr. Bartley said this would be another form of Poor-law; but he hoped gentlemen would look this straight through, and keep the distinction in mind. It might be called Poor-law, exaction, tyranny, or anything else; he called it justice, but he did not care so much about the name. The difference between what Mr. Bartley said was a new form of Poor-law and the old was this,

that in the old form, every thrifty man had to pay for every wasteful one; in the new form, every man would have to pay, as he should justly pay, for himself. There was all the difference in the world between those two things. Then Mr. Bartley said, with regard to sick persons, this did not differ from a friendly society. If it did not, he would not say friendly societies should be abolished, because there might be imposition. But this system provided for pensions besides sick pay, which made all the difference. But Mr. Bartley said something else, which he had warned speakers against saying; he spoke of the friendly societies which had been so much abused. Now, he challenged any person to show where he had abused friendly societies. He always said that good friendly societies were better than none. Mr. Hale seemed to think he had spoken hardly against the poor, but it was nothing of the kind, he had spoken against a system which made them poor. It was quite true the Scripture said the poor should always be with us, but it never said the pauper in our sense of the word pauper, and it never said that we should manufacture paupers by thousands and millions. It was to the interest of the poor of London that he moved in this matter. The burial fund again was referred to by Mr. Bartley, but he left the burial fund out altogether, and he thought, really, that to confuse this question with the little sums that people paid in order to have a respectable coffin when they were buried, was not worthy of the occasion. Those who were thrifty could make any provision they thought fit about that, but his scheme did not go to compel people to have any particular sort of coffin or cavalcade. Then Mr. Bartley said, again, that people would learn they were drawing from an Imperial fund, but it was not so; every person would understand they were drawing from their own fund, and not from the nation. If imposition were practised, they would soon understand that the rate everyone would have to pay would be increased, and therefore everyone would have an interest in keeping that rate down. Again, with regard to the question of imposition, those who argued from that point of view ought to argue against all friendly societies. The truth was, friendly societies either prevented or paid for imposition, and why should not national insurances do the same. It was quite overlooked in national insurance. You might have fifty safeguards against imposition, which did not exist at the present time. The law might establish a great many. The population of an entire village would be assured, everyone would have to go to the Post-office and receive his sick pay; there would be first of all the medical certificate, which at any rate amounted to a presumption that the person was not quite well, and besides that, what tremendous restrictions there would be against anyone defrauding the fund. They would not dare show their face in the public house, they would not be able to go more than a certain distance from home. Their name would be put up at the Post-office, where everybody who came would see who was sick, so that the whole population would really act as a check upon imposition. Besides, there was no reason why there should not be a Board elected by everybody who paid in the insurance, before whom people should go, and regulations could be made stringent enough to prevent any imposition. He was always pleased to hear ladies address a meeting, but he did not quite see the force of Mrs. Heatherley's objection. She said the club she had to deal with did not answer because they had to pay 3d. a week, and they had to cut it down to 2d. If that principle were acted upon, they would like a club best in which they had only to pay 1d. a week, but such an arrangement would not give any security at all. This question of imposition was entirely a matter of management, which he begged people to keep in mind. He had in his hands the papers of two women's clubs, one a female club which was established in Shropshire in 1829. It had a membership of 285 women; no member had ever been in receipt of parish relief, and it was most successful. The other one was the Stock and Walford Union, which was well known to every one acquainted with the subject, as one of the earliest and most successful friendly societies. It was a male and female club; there was only one restriction on the receipt of the medical pay for women, and in every other respect the men and women being on exactly the same footing. It was established in 1828, it had a membership at present of 1,426, and it had a fund now in hand equal to more than £30 for every member; the assets being £46,000. That showed that a woman's club was not impossible, if it were managed as it ought to be. Mr. Walford said it would be a cruel thing to abolish the Poor-law, and to leave those who had been depending on the Poor-law to perish. So it would, and he never proposed it. But henceforth he would make everyone too rich to require poor relief; he would have a provision against sickness, and old age, and would not have to go to the workhouse. He did not say that men from 40 to 60 years of age would not have to do so, but they must let the Poor-law die out gradually. He would not abolish the Poor-law, but pauperism, and if people could not be paupers, there might be one thousand Poor-laws, and they could not do anybody any harm. Another gentleman said the Poor-law system was not answerable for making paupers. If not, what was responsible?

Mr. Knowles—Drinking.

The Rev. Mr. Blackley said the Poor-law allowed a man to say—I can drink as much as I like, and then come on the rates; that was the whole point and gist of the matter. If it were not the Poor-law which made pauperism, why were there no paupers in other countries? There were poor people, but there were not paupers in our sense. Then there was the question of identification, and Mr. Bartley spoke of branding the people with a "B"—whether it was to stand for Bartley or Blackley he did not know—but this question of identification was the simplest in the world. It would not be if you had a lot of little independent societies, assuring some people here and some there, but in a nation where everybody had one ticket he could only present one, and it was absolutely impossible there could be any impositions. If a man had 20 tickets he could only be paid for one. It would be just as simple as paying in the money. Many people talked of that being an expensive and troublesome thing, but the payment would only be going on during three or four years, and steady men might have it made in three payments once a year. But even if it were done every three months, so that there were 12 payments, the expense of that would be very simple, compared to the expense of making payments in ordinary friendly societies, which had to be done once a month during a man's whole life. Really, if gentlemen and ladies would go through the thing a little carefully, and examine how these points could be met, they would be astonished how these objections to the scheme faded away. He did not feel a bit further down from what had been said, and really did not believe the objections were substantial. No doubt they would be put forward again, but by degrees they would disappear, for, as far as he could see, there was nothing at all vital in them. It was said that a revolution would be caused about this, but when he went to poor men and showed them the benefits of the scheme, he always found them very willing to accept it. If he went to a man who had two sons, and asked him if one was to be compulsorily insured, and the other not, which he would think was the best off, would he not say the insured one? This was a question for the poor, and he found the poor taking it up with heart and hand. When you came to the educated and instructed working man, he saw through it in a moment, and said it would be a blessing. The people who objected were interested officials of bad societies. He had there the report of the Parlia-

mentary Committee on Friendly Societies, in which Sir George Young said that the people concerned in friendly societies would oppose the Government interfering in any way; but the thing put before him was not voluntary insurance, but compulsory, and it would be impossible, through the whole of that evidence, to find six answers given by persons who were not officials of these friendly societies.

A Member asked if Mr. Blackley would kindly point out how the £10 would be sufficient to give a man an annuity at 60 years of age.

The Rev. Mr. Blackley said that sum of money, if paid in at first would have 43 years to accumulate. As far as the pension went, that would have 40 years to accumulate; as far as the sickness went, there would be a deduction, but the sickness would be very much less at first than at the last. Moreover, this fund would be a national fund—not a thing to be handed over to the Government; not a thing for any one to disestablish or disendow, or for another to invest in railways abroad. It would belong to the people; and they would appoint proper persons to take care of it, who would act as trustees. There would be no reason why they should not get better interest than the ordinary interest of the Funds, and for that reason it would accumulate much more largely. He laid it down that £10 would be sufficient; and he believed that less than £10 would; but even if it cost £11 or £12, that was not an essential feature of the proposal. The nation was rich enough, and paid its workers enough to enable every man and every woman to make proper provision for their youth, manhood, and old age, and, therefore, what he proposed to do was, to make every one make that provision, and they would be the happier and better for it.

The Chairman then proposed a vote of thanks to the lecturer for his very able discourse. They would all agree that the reverend gentleman had given a great deal of time to this subject, and handled it very ably and eloquently. Every one must admit that this was a very legitimate subject for consideration, and one of the most important that could be brought before the nation. To-day they had only been discussing principles, and had not had before them the details and machinery, on which a great deal would depend; but, if they agreed to the principle, the details would have to be carefully considered, whereby the whole thing might be carried into operation. They would all agree in offering their sincere thanks to the reverend gentleman for his kindness in giving the lecture, and assure him they would all take it into their serious consideration.

The motion having been carried, **Mr. Bartley** proposed a vote of thanks to the Chairman, which was seconded by **Mr. Walford**, and carried unanimously.

CORRESPONDENCE.

NATIONAL EDUCATION AND COLONIAL RESOURCES.

I desire to draw the attention of the Society of Arts to a question which appears to me of extreme importance, hoping the Council may take some steps to organise inquiry into facts.

The problem, in broad terms, is this:—How far is our national system of education responsible for the vast ignorance of the population of the United Kingdom on the subject of the resources and advantages possessed by our Colonies?

I need not dwell upon the well-known fact that the great main stream of emigration from the United Kingdom flows into the United States, nor remind the Society that these tens of thousands of our country men, finding homes in that territory, not only cease to be factors in the sum of British industry and art, but cease even to be Europeans; but I venture to ask the Council to take some steps with the view of ascertaining what are the causes which have produced, and are producing, a positive dead loss in our national producing power, while our own territories, with equal, if not greater, advantages, lie waste for lack of people.

Can it be that the children of the working classes of the thickly-populated United Kingdom are, at public expense, taught more of the history, natural features, extent, resources, and government of foreign States than of their own possessions? Could not, and should not, some national system be devised to popularise information concerning the splendid field offered to industry by Canada, Australia, New Zealand, and the Cape, where an Englishman does not cease to be a British artisan, farmer, or labourer, nor change his nationality because the consequences of increase of population in these two small islands compelled him to seek a home across the sea.

J. C. R. Colomb, Captain, R.M.A.,
J.P. in Co. Kerry.

Droumquinna, Kenmare, Co. Kerry, Ireland,
8th July, 1880.

GENERAL NOTES.

Royal College of Music.—A Parliamentary paper has been issued, containing a copy of a petition of the Prince of Wales to the Queen in Council, praying for the grant of a charter of incorporation to the Royal College of Music, and a draft of the charter prayed for. The petition mentions the educational success of the National Training School for Music, established in 1875 at Kensington-gore, and the fact that it has been endowed with considerable annual grants by various donors; and proceeds to allege that musical education would be still further promoted if a Royal College of Music should be established and incorporated, which should absorb the existing training college. The charter incorporates the Prince of Wales, the Duke of Westminster, and Sir Richard Wallace, and all other persons who may become members of the corporation, as a body corporate by the name of "The Royal College of Music." By the charter the Prince of Wales is to be the first president, and any vacancy in the office is to be filled up by the Crown; the vice-presidents are to be appointed by the president. There are to be a principal and vice-principal, both professional musicians. The council is to consist of the president, principal and vice-principal, and 30 ordinary members retiring annually by thirds. There is to be a staff of masters and assistant masters and a Board of Studies. The pupils are to be divided into three classes—(1) Scholars whose education and maintenance are either wholly or partially defrayed gratuitously; (2) Government pupils, whose education is conducted in manner and on the terms agreed upon between the college and the Government; (3) students—*i.e.*, pupils who pay for the whole of their education. There are to be graduates and fellows, as at a University.

MEMBERS' SUBSCRIPTIONS.

The Midsummer subscriptions are now due. Cheques or Post-office orders for the above should be made payable to H. T. Wood, or order, crossed "Coutts and Co."

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health will be published shortly, price 1s.

Applications for copies of the Report should be addressed to the Sceretary.

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FRIDAY, JULY 30, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SCHOOL BOARD DRILL.

The annual drill competition of the London Board schools, for the challenge banner presented by the Society of Arts, took place on Friday morning, the 23rd inst., in the grounds of Lambeth Palace. On this occasion, as in 1879, a selection was made out of about 50,000 boys, consisting of ten companies of forty boys each, from the following schools: — Olga-street, Bethnal-green; London-fields, Hackney; Mantua-street, Battersea; Canterbury-road, Old Kent-road; South Lambeth-road; Bloomfield-road, Plumstead; Waterloo-street, Hammersmith; Keeton's-road, Bermondsey; Sumner-road, Peckham; Thomas-street, Limehouse. The boys were inspected by Colonel Battersby, Commandant of the Royal Military Asylum, Chelsea, who expressed himself much pleased with the creditable manner in which they went through the various movements. He awarded the banner to the Thomas-street School, which had won it in the previous year. Sir Charles Reed, M.P., Chairman, the Rev. J. Rodgers, Vice-Chairman, and several members of the School Board, were present, and also Major-General Sir T. MacMurdo, K.C.B., and Mr. E. Chadwick, C.B., Vice-President of the Society of Arts.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

LECTURE I.—DELIVERED FEBRUARY 2, 1880.

Sources of India-rubber—Chemical and Physical Properties—Behaviour with Chemical Re-agents—Action of various Solvents—Effects of Heat, Cold, and Light.

India-rubber or caoutchouc possesses properties so widely different from those of most other substances, that it became an object of very great interest as soon as it made its appearance in the civilised world, and its industrial importance has rapidly increased as the knowledge of its remarkable characters and manifold applicability has become more extended. At the present time, caoutchouc holds such an important position with regard to the economy of modern arts and manufactures, that were it suddenly to be withdrawn from circulation, many minor industries would in consequence cease to exist; while numerous large and important branches of handicraft would languish until arrangements could be made to adapt their operations to the altered circumstances.

It is, however, during the last forty years that india-rubber has enjoyed its greatest triumphs as an industrial agent; that is to say, since the art of vulcanisation was discovered and perfected by the labours of Charles Goodyear, Thomas Hancock, and others.

The earliest rumour of the existence of caoutchouc reached Europe nearly 500 years ago; the first visit of Columbus to Hayti having brought to light the fact that the natives of this island were in the habit of making playing balls of an elastic gum. Nothing more appears to have been heard of india-rubber until Torquemada, rather over 250 years ago, described the Mexican Indians as not only making playing balls of india-rubber, but also as fabricating helmets, shoes, waterproof fabrics, and other articles of elastic gum. This writer gives some details as to the collection of the juice and the making of various articles from it, thus giving us the first view of the india-rubber manufacture as a branch of industry. We do not hear, however, of samples of india-rubber reaching Europe until long after this, and little more appears to have been learned regarding the substance until the celebrated French naturalist, La Condamine, made a communication to the Academy of Sciences at Paris concerning caoutchouc, he having had ample opportunities of studying the subject in Para. In the memoir in question, La Condamine gives very detailed particulars regarding the Para india-rubber tree, the collection and treatment of the juice, and the methods made use of by the natives for the production of various articles of caoutchouc. He tells us that the substance in question was used for making torches, these being only an inch and a half in diameter by two feet long, and yet burning for 12 hours. Again we hear of the use of india-rubbber for the making of playing balls, and it appears that the natives were in the habit of using enema or injection bottles made of caoutchouc.

Soon after La Condamine's communication to the Academy of Sciences, samples of india-rubber frequently reached Europe, and scientific men began to make investigations regarding this remarkable body. Between 1760 and 1770 we find Fresneau and Macquer studying the subject, and the last-named investigator made tubes and other articles of caoutchouc by dissolving it in ether and coating moulds with the solution, so that a solid skin of caoutchouc should remain adherent to the mould, on the evaporation of the solvent.

From this time until the end of the eighteenth century, the india-rubber industry may be considered to have been undergoing its period of gestation, and to have been born with the dawn of the present century. Among the first of the important patents regarding the utilisation of caout-

chouc, is that granted in 1823 to Charles Macintosh, for dissolving the substance in coal oil, or coal naphtha, and the use of this solution as a waterproofing agent. I have here a specimen of such a solution, as now manufactured by Messrs. Chas. Macintosh and Co., of Manchester, together with some examples illustrating its uses.

About the same time, elastic webbing was first made with threads, cut from the raw rubber, and other minor applications of caoutchouc to the industrial arts were adopted from time to time, until the great discovery of vulcanisation inaugurated a new epoch in this branch of industry; rendering it possible to so far alter caoutchouc, as to make it

Fig. 1.



Hevea guianensis.

capable of resisting, to a great extent, the action of heat on the one hand, and cold on the other hand.

The milky sap of many plants contains caoutchouc, suspended in the form of minute transparent globules, these being frequently as small a $\frac{1}{20000}$ to $\frac{1}{50000}$ of an inch in diameter; but com paratively few plants contain sufficient caoutchou to render them important sources of this body.

The trees which yield the largest supply of the best quality of caoutchouc, consist of various species of hevea, which flourish in the northern districts of South America, especially in the province of Para, some portions of the valley of the Amazon being crowded to an extraordinary extent with heveas. The abundance of the india-rubber trees in Para may be judged of by the fact that this province alone exported 7,340 tons of caoutchouc in the year 1877; more than half of this being sent to Liverpool.

Among the heveas most productive of caoutchouc may be mentioned the *Hevea brasiliensis*, which flourishes in Para, and yields some of the finest caoutchouc, and often attains a height of 60 to 70 feet, with a diameter of nearly three feet; the *Hevea guianensis*, a similarly magnificent tree, likewise abundantly productive of caoutchouc

FIG. 2.



COLLECTION OF THE JUICE OF THE INDIA-RUBBER TREE IN PARA.

and the *Hevea spruceana*, a smaller tree, which grows almost exclusively in the province of Para.

I now project on the screen a lantern slide representing a forest of heveas, and next I will show you one which will give you some idea of the foliage and flower of the *Hevea guianensis*. (Fig. 1, p. 754.)*

The operation of collecting the juice is well illustrated by the drawing (Fig. 2, p. 755) which is now projected on the screen. A series of cuts being made through the bark of the tree, either shells or clay vessels are attached to receive the exuding milky sap and when sufficient of this has been collected, the operation of drying it is performed as follows:—A kind of wooden bat, thinly covered over with clay, is dipped into a pail filled with the juice, and the bat, thus coated, is held over a fire, fed with certain wild nuts, which, in burning, give off abundance of aromatic smoke. The picture now on the screen (Fig. 3, p. 758) represents this operation, and you will see that a kind of short chimney is fixed over the fire to lead the smoke compactly upwards. As soon as the first layer of juice has become indurated, the bat is again dipped, and the drying operation is repeated; layer after layer being thus dried on the bat, until a thickness of nearly an inch is attained. A knife cut is now made in the bottle or biscuit of caoutchouc thus obtained, so that it can be removed from the wooden bat, and exposed to the air to become still further indurated. Para caoutchouc, prepared in this manner, has a fragrant aromatic odour, which you can study for yourselves in the samples now before you.

The residues of juice left in the various vessels employed, the scrapings of the incisions, together with other materials, which the ingenious native thinks he can shuffle off on the unsuspecting merchant as caoutchouc, are made into balls, and sold as "negro head." The negro head-rubber is frequently made into crude representations of animals, and there are several such works of native art on the table—as, for example, this specimen, which will pass about equally well for a horse, a pig, or a crocodile. For the opportunity of showing you this very fine collection of specimens of raw rubber, I have to thank the Silvertown Company, Messrs. Tuck, Messrs. Macintosh and Co., and others. Your attention will be specially called to some of these shortly.

Here is a piece of Para bottle-rubber, which has been boiled for some hours in water, and you see that it is now so far softened as to render it easy to pull asunder the several layers of which it is composed, its laminated structure being thus very well illustrated.

The milky juice of the Para rubber trees, of which you see a specimen before you, has approximately the following composition:—

Caoutchouc	32
Albumenous, extractive, and saline matters ..	12
Water	56
	100

As a rubber-producing tree, the *Ficus elastica* stands next in importance of the heveas. The *Ficus elastica* grows abundantly in India and the East Indian Islands, one district in Assam, thirty miles long by eight miles wide, being said to contain 43,000 trees, many of them attaining a height of a hundred feet. This tree also grows freely in Madagascar, and it is well known to us as a greenhouse plant. The slide now projected on the screen represents the *Ficus elastica* in its native regions; and I will next show you one illustrating a *Ficus elastica* now growing out of doors in the Parc Monceau at Paris. (Fig 4, p. 759.)

The juice of the *Ficus elastica* contains notably less caoutchouc than that of the American trees, the proportion very often falling as low as 10 per cent of the juice.

A vine-like plant, the *Urceola elastica*, which grows abundantly in Madagascar, Borneo, Singapore, Sumatra, Penang, and other places, yields a considerable amount of caoutchouc of very good quality, and you will find specimens of the substance from these districts on the table.

Africa yields a considerable quantity of caoutchouc, but generally soft and of inferior quality. It is believed to be yielded by various species of landolphia, ficus, and toxicophlea. Here are some specimens of African rubber. This specimen, representing the quality known as African ball, being tolerably firm in consistency, while the African flake, which you see here, and the African tongue represent the lowest and most viscous qualities of commercial rubber. In order that you may compare the two extremes of quality, I will hand round a specimen of fine Para together with a piece of African tongue.

The commercial value of the various qualities of rubber may be estimated, to a certain extent, by noting the loss which the samples undergo during the operation of washing, which operation will be described in the next lecture; and also by noticing how far the various samples are softened by a long continued gentle heat. Here are some samples which have been heated for some hours in this water oven; you will notice that the African tongue has become almost as soft as treacle, while the Para rubber still retains its form, and much of its consistency. The purification of caoutchouc will be considered next week, but your attention will now be called to the properties of pure caoutchouc.

Caoutchouc is nearly colourless, and when in thin leaves tolerably transparent. It, like very many other substances, contains nothing but carbon and hydrogen, but its properties differ very widely from those of other hydro-carbons almost identical in composition. It has been found to contain, in one hundred parts, 12·5 of hydrogen and 87·5 of carbon. Caoutchouc, as might be supposed, burns very readily and leaves no residue; if I set fire to a few ounces, you see how it blazes up. It is soft, and very imperfectly elastic, in the true sense of the term; that is to say, it does not return to its old dimensions after having been considerably stretched. Here is a strip of pure (*i.e.*, unvulcanised) caoutchouc a foot long; you see that I have stretched it to a length of three feet, and, after holding it stretched for a few seconds, I relax it. It now measures, as you see, several inches over the foot. The elasticity of caoutchouc may be enormously increased by vulcanisation, as I will illustrate to you in future lectures.

As regards the stretching of india-rubber, there

* This engraving, and also some of the other blocks used to illustrate these lectures, are taken from Figuier's "Merveilles de l' Industrie," permission for their use having been granted by the publishers, Messrs. Furne, Jouvet, and Co.

is a point at which it requires a greatly increased force to stretch it, and at this point it seems to become fibrous in texture, as you may perceive, by examining this extended sample by the aid of a magnifying lens. India-rubber has valuable electrical properties, as you are no doubt aware, it being an admirable insulator, and having a great tendency to become electrical by friction.

Freshly-cut surfaces of india-rubber cohere very strongly when brought into contact, and this is well illustrated by the old way of making a tube of unvulcanised caoutchouc. You see that I wrap a sheet of caoutchouc round a mandril, so that the edges project parallel to each other. These parallel edges being cut off by means of scissors, the freshly-cut edges adhere, and a perfect tube is the result. Toy balloons are made in a somewhat analogous manner, as I shall illustrate in the next lecture, these being cold vulcanised afterwards.

Either French chalk or soapy water is of constant use in the rubber factories, to prevent the adhesion of new surfaces of caoutchouc to each other, or to other substances.

Cold has a remarkable effect on caoutchouc, rendering it rigid and inelastic, and this circumstance considerably detracts from the value of unvulcanised india-rubber. Here is a strip of india-rubber; you see that it is quite soft and pliable. I will now expose it for a few minutes to a temperature of 0° Centigrade, or the freezing point of water. It becomes, as you see, rigid and stiff, but its original pliability may be restored, either by warming or by applying sufficient tensile strain to it, to extend it to three or four times its length. One half of this strip I will warm in water, heated to 50° Centigrade, and the other I will stretch. In each case you see that the caoutchouc is restored to its original condition. In the case of the stretching it is very likely that the effect is due to heat evolved during that operation. It is easy to illustrate the fact that heat is produced when india-rubber is subjected to tension. Here are some strips of india-rubber, arranged side by side on a board. I bring them in contact with the bulb of an air thermometer, and you see that there is no indication of either heat or cold. The strips of india-rubber being now stretched to four or five times their previous length, the air thermometer indicates a considerable rise of temperature. Here is a similar set of strips, which were stretched some hours ago, and which, on trial by the air thermometer, we now find to have cooled down to the temperature of the surrounding objects. Note the effect of releasing the tension, and allowing the rubber strips to contact. You see that they have become so cold as to influence the air thermometer to a very considerable extent.

The effects of heat on india-rubber present many points of interest, and, in the first place, I wish to illustrate to you the effect of moderate heat on a stretched band of caoutchouc. Here is such a band, one end being attached to an index, pointing, at the present time, to the zero of this paper scale. Notice the consequence of applying a gentle heat to the caoutchouc band—it contracts as regards its length, but expands in a transverse direction, causing the index to move rapidly through a space of several degrees. This property, which stretched caoutchouc possesses, of contracting by heat, may be described by saying that, within certain limits, the tensile elasticity of caoutchouc is increased by an elevation of temperature. Caoutchouc, however, if heated to 100° Centigrade, softens considerably, and almost entirely loses its elasticity, as you will perceive by examining this sample, which has been heated for some hours; while a heat of 120° Centigrade produces a most decided softening effect on caoutchouc of the best quality, but after exposure to this temperature, it recovers its pristine state by exposure to cold for a moderate period. If, however, the action of heat has been pushed still further, say to 200° Centigrade, the caoutchouc becomes converted into a permanently viscous body, which has little or no tendency to harden again. This viscous substance possesses the same composition as unaltered caoutchouc, and is of value as a medium for making air-tight joints, which can be easily undone. This glass jar has its top edge ground level, and, after applying a little of the heated caoutchouc to the ground edge, the jar may, as you see, be hermetically closed by a disc of plate-glass. A joint of this kind may be broken and re-made with the utmost facility and rapidity. I pass the jar round, and you can study the matter for yourselves.

When cautchouc is subjected to a temperature somewhat above 200° Centigrade, it becomes converted into a variety of volatile hydro-carbons, which present many points of interest, and you will find a tolerably full account of them in the manuals of chemistry. In this retort, the dry distillation of caoutchouc is being carried on, and in time very nearly the whole of the india-rubber will be converted into the mixture of oily hydro-carbons, only an insignificant carbonaceous residue remaining in the retort. The mixture of volatile hydro-carbons, often referred to as caoutchoucin, forms a very good solvent for caoutchouc and certain resinous bodies.

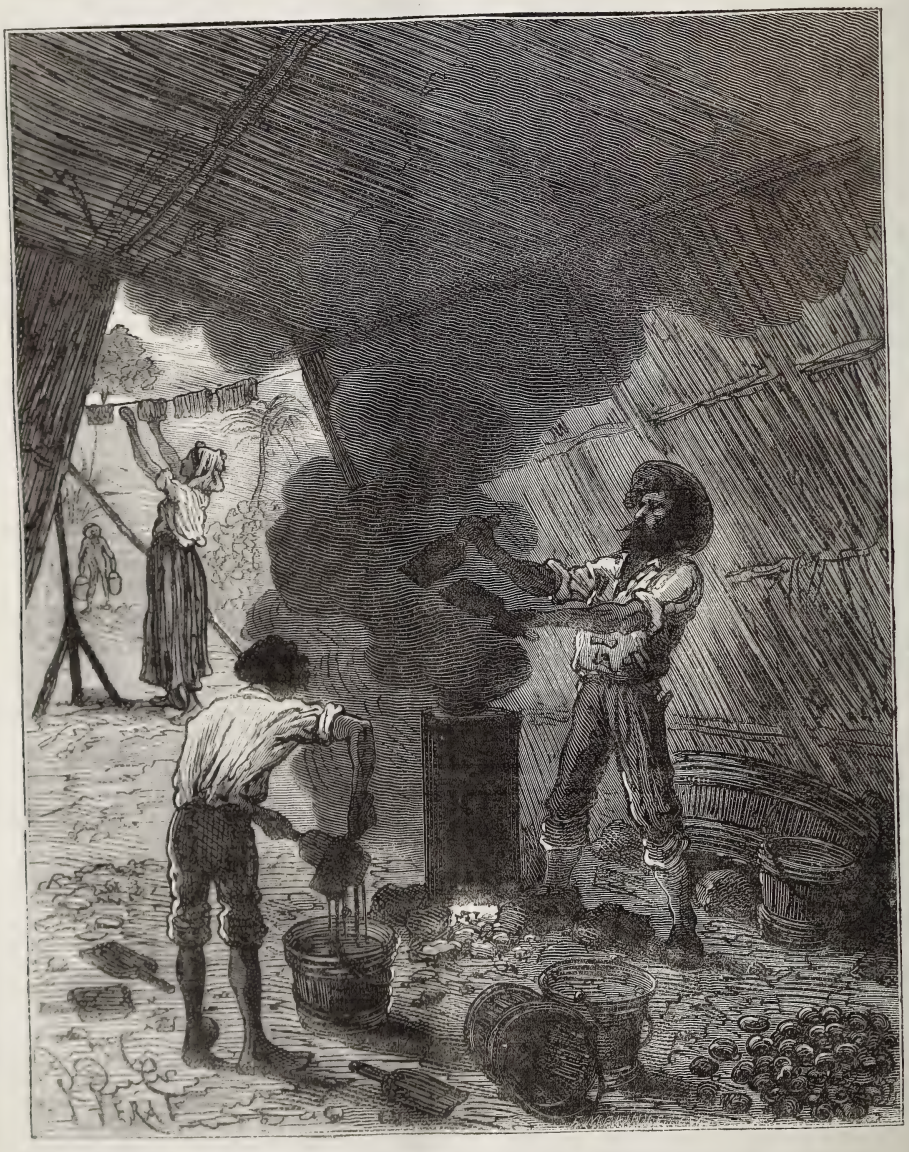
India-rubber is subject to two kinds of deterioration and decay. In one instance it tends to become soft, and loses its elasticity, while in the other it becomes friable, yellowish, and resinous in its nature. Examples of each kind of deteriorated rubber are on the table, and you will notice that, in the case of this specimen, we have a well-marked instance of both kinds of deterioration going on side by side. The last-mentioned kind of deterioration has been clearly and indubitably traced to an oxidation of the caoutchouc. This oxidation is tolerably rapid when the caoutchouc exists in a finely divided state, and when it is exposed to damp at the same time; but the alternate damping and drying of the caoutchouc tends more towards its rapid oxidation than does a continual state of dampness. The resinous matter resulting from the oxidation of caoutchouc has been carefully studied by Spiller, who found that a sample of felt, originally composed of cotton fibres and india-rubber, had become so far changed during six years, as to contain no trace of caoutchouc; but in its place he found a resinous substance resembling shellac. This resinous body, of which a sample is before you, is easily soluble in alcohol, and also dissolves in benzole. Alkalies dissolve it readily, and acids precipitate it from the alkaline solution. It contains 27·3 per cent. of oxygen.

The conditions under which the softening of

the india-rubber takes place are not so well understood, but there is some reason to believe that this is due to incipient oxidation.

Ozone oxidises caoutchouc with extreme rapidity, as Warren pointed out in 1877, and I have arranged a simple experiment to illustrate this fact. Through the open end of this glass passes a slow stream of air which has been slightly ozonised; that is to say, a portion of its oxygen has been converted into ozone. When the stream of ozonised air is allowed to impinge on a surface of india-rubber, you see that the surface is instantly corroded and roughened. Again, note the effect of allowing the ozonised air to act on the surface of a distended caoutchouc balloon—you see that it bursts immediately. I should mention, by-the-bye, that in the case of these balloons, the caoutchouc is slightly vulcanised, but the action of

Fig. 3.



The Operation of Drying the India-rubber Juice.

ozone on vulcanised india-rubber is similar to its action on the unvulcanised material.

It is extremely probable that the rapid deterioration of caoutchouc, which is known to take place under conditions which are not perfectly understood, is frequently due to the corrosive and oxidising action of ozone.

Ozone, or some agent nearly resembling it, is often produced when oil of turpentine is exposed to the air, and this circumstance may perhaps ex-

plain the destructive influence which oil of turpentine occasionally exercises on india-rubber.

The whole subject of the deterioration of caoutchouc is one of great interest from a practical point of view, but to enter into its discussion would consume the whole of the time allotted to the present course of lectures.

Exposure to sunlight often causes the destruction of india-rubber, either converting it into a soft and sticky substance, or into a hard body, less soluble

FIG. 4.



FICUS ELASTIUS; A SPECIMEN GROWING IN THE OPEN AIR AT PARIS.

in benzole than unaltered caoutchouc; and it is quite possible to obtain a photographic print by exposing a film of india-rubber under a negative, and then dissolving away those parts on which the light has not acted, by means of benzole. Here is such a photograph made by Mr. Woodbury. I now project it on the screen, so that you may all see it. It is generally a discreet thing to keep india-rubber where it will not be exposed to the prolonged action of a powerful light, although

there are cases in which exposure to light is a useful aid to the process of vulcanisation. India-rubber is, to a certain extent, porous and cellular in its texture, as may be seen by a microscopical examination of a thin section. Again, if a thin leaf of caoutchouc is boiled for a long time in water, it absorbs a considerable proportion of this liquid. You see that this piece of caoutchouc has become quite milky and translucent from the absorbtion of water, and it probably holds, at the present time, as much as 10 or 15 per cent. of water. The amount absorbed may, in some cases, rise as high as 25 per cent. In a similar manner alcohol is absorbed by india-rubber, but this fluid is absorbed more readily than is the case with water.

Now, we pass on to a more important matter, namely, the action of such liquids as benzole or coal naphtha on caoutchouc. Here are two cubes of Para rubber, each being three-eighths of an inch across the face. One of these I will preserve as a pattern, and the other I will suspend in a bottle containing benzole. The cube suspended in the benzole will immediately begin to swell, and will continue to do so until it has attained a bulk about one hundred times as large as its original size. During the time that the cube is swelling in the benzole a certain proportion of the caoutchouc will become dissolved out, and incorporate itself with the bulk of the solvent.* Now, as a matter of fact, every kind of natural india-rubber contains two distinct modifications of caoutchouc, one of which tends to swell up in such a liquid as benzole, while the other dissolves and forms a true solution. The first mentioned of these bodies may be referred to as the fibrous constituent of caoutchouc, while the second may be spoken of as the viscous constituent. The proportions in which these two bodies occur in raw rubber varies extremely; Para rubber, of good quality, containing only a small proportion of the viscous constituent, while African tongue, on the other hand, consists principally of the viscous modification of caoutchouc. The viscous constituent of caoutchouc is the agent principally concerned in the joining together of freshly cut edges of india-rubber; and as we proceed with the study of caoutchouc, we shall see that, under certain conditions, the fibrous caoutchouc can be more or less perfectly changed into the viscous form. The treatment of the juice of the india-rubber trees is often of such a nature as to greatly deteriorate the caoutchouc obtained; a considerable proportion being thus changed from the fibrous to the viscous condition. This kind of injury to the caoutchouc can be obviated by coagulating the milky juice, and carefully drying the clot after it has been subjected to pressure. For experimental purposes, alcohol may be employed as a coagulating agent; while, on an industrial scale, alum has been tried with apparently an excellent result. The milk is strained to remove solid impurities, after which a small proportion of alum solution is added. The clot which separates is next drained or pressed, after which it is dried. Caoutchouc dissolves more or less perfectly, according to its condition in various liquids, among which may be mentioned the various fixed and hydro-carbon oils, chloroform, ether, and carbon disulphide. Unless, however, the caoutchouc has been masticated or otherwise degenerated, it is doubtful whether a true solution is obtained. When a clear limpid solution is required, one of the best solvents is that proposed by Payen, namely, carbon-disulphide, mixed with 5 per cent. of absolute alcohol. If one part of masticated caoutchouc is dissolved in 30 parts of the above solvent, a solution is obtained which can be filtered through paper, and may be employed in covering the most delicate moulds with successive layers of caoutchouc.

Caoutchouc may be utterly ruined by the use of impure solvents, and those experimenting with india-rubber solutions should, in cases where it is disirable to regenerate the caoutchouc by allowing the solvent to evaporate, take the utmost care not to employ any solvents which contain fatty or greasy matter.

Weak or diluted acids have little or no action on caoutchouc in the majority of cases, but strong sulphuric acid slowly acts on it, the action becoming rapid if heat be applied. Strong nitric acid acts on it with some energy, causing its entire destruction, and in a similar manner, it is destroyed by the prolonged action of chlorine, bromine, or iodine; although these re-agents, when their action is kept under control, have a vulcanising or strengthening action, which will be referred to later on.

Regarding the action of sulphur on caoutchouc, much is to be said, but not at present. Alkaline solutions have little or no action on caoutchouc.

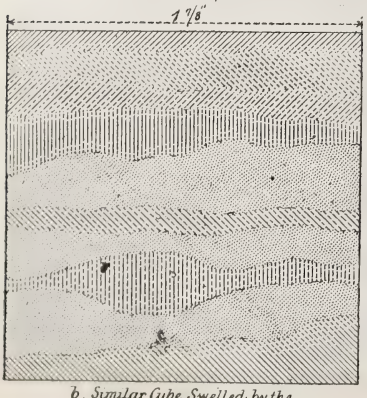
* At the close of the final lecture, the cube immersed in the benzole was examined, and found to have swelled to 125 times its original volume, and in swelling it very clearly displayed the laminated texture of the rubber-bottle from which it was cut. The relative sizes of the two cubes and the texture of the swelled cube are illustrated in the following diagram:—

Fig. 5.



a. Cube of Para Caoutchouc Unswelled.

Fig. 6.



b. Similar Cube Swelled by the prolonged action of Benzole.

The angles of the swelled cube were quite sharp and well defined, the fibrous rubber having no tendency to dissolve in the benzole. If the swelled cube had been removed from the benzole at this stage and allowed to dry, it would gradually have assumed a volume slightly under its former size, and would have weighed somewhat less, owing to the loss of the viscous or soluble constituent.

MISCELLANEOUS.

AYLESBURY SEWAGE WORKS.

The drainage works of the town of Aylesbury, at which place the A B C process of disinfection is in operation, were visited on Monday, 26th inst., by a large party, consisting of deputations from the corporations of several towns, members of Parliament, and others interested in the practical treatment of sewage. The purification is effected by making the whole sewage of the town, as it enters the works, turbid, by running into it a mixture of blood, charcoal, and clay, each of which exercises its own peculiar action upon the dissolved, as well as the suspended, impurities. This turbid stream is then treated with a salt of alumina just as it enters the tank, the action of which is instantly to precipitate the whole of these impurities to the bottom. The sewage was seen from its first admission to the tanks till it ran out sufficiently pure to be passed into the river. All offensive odour is arrested by the addition of the purifying agents. The deposit or sewage sludge is pumped into a reservoir, from which it descends into a press. The water is then squeezed out, and solid cakes of manure, containing about 40 per cent. of moisture, are produced. These are afterwards dried and prepared for the market. The output is about 10 tons a week of powdered guano, which sells for £3 10s. per ton. The amount of impurity in the effluent water is stated to be considerably below the standard demanded by the Rivers Pollution Commission. Some of this water was sent to the Berlin International Fishery Exhibition in competition for the prize offered by the King of Saxony for the best practical scheme for rendering harmless to fish in rivers and lakes, the refuse from factories and sewage of towns falling into them. The award of this prize, however, was postponed on account of the small number of entries for it.

PETROLEUM AS FUEL.

The mail steamer *Cesarewitch* is described by the special correspondent of the *Daily News*. It is English-built, and is the swiftest mail steamer on the Caspian, being only surpassed in speed by the *Nasr Eddin Shah* war steamer. To convey it from the Baltic to the Caspian it was necessary that it should traverse the whole of the Neva ship-canal, and afterwards descend the Volga to Astrakan. On the Neva Canal are fifty-four locks, and the *Cesarewitch's* length was too great to allow of her entering them. Her present chief engineer, Mr. Vine, an Englishman, cut her into two pieces amidships, and filling up the open extremities with iron bulkheads, floated her in this guise through the canal. At Astrakan the same gentleman put her together again, and has remained ever since in charge of her machinery. Her boilers are heated by petroleum refuse instead of coal, a system which effects an enormous saving of expense and labour, the heating apparatus being as thoroughly under control as a gas jet, and requiring but one man to manipulate it. It consists of two tubes, about an inch in diameter, terminating at the same point in a small oblong brass box. Through one of these tubes the black residual naphtha (*astatki*) drops slowly, being blown into spray by a jet of steam from the boiler, conveyed through the second tube. This spray, when ignited, forms a great sheet of flame, which is projected into the hollow of the boiler. It has the immense advantage of requiring no stoking, as no ashes are produced; and by turning down the flame to the required degree, the steam can always be kept up to the pressure required for immediate starting without the tedious and more or less wasteful process of "banking" the fires. An arrangement like this is invaluable for cruisers lying off an enemy's port, and requiring to hold their steam in readiness. It is intended to apply the same system of heating to the locomotives on the Tiflis Baku Railway, when completed; and it will, doubtless, play an important part in the steam communications destined at no distant period to traverse the Steppes to Khiva and Samarcand.

SINGING IN SCHOOLS.

Mr. Henry Leslie makes the following remarks on the annual cost of singing in Public Elementary Schools, in a letter addressed from Bryn Tanat to the editor of the *Times*:—

"The enormous sum of £120,000 is annually paid by Government for musical results in Board and denominational schools. And what are the musical results? Simply singing by ear, and that, frequently, as I can testify, very much out of tune. Although I am one of the managers of four schools in this neighbourhood, and rejoice over the amount added to school funds by this grant from Government, yet speaking as a musician, I consider it as utter waste. I am aware that singing from notes will be required in future to gain the shilling a head, but sixpence a head will still be obtainable by singing from ear. If out of this annual sum of £120,000 one penny in the shilling were deducted for the endowment of artistic musical education, the necessary income of £10,000 would be secured, and a new era inaugurated. The Royal Academy of Music, the National Training School, and the newly proposed Royal College would, beyond their attention to art education, be able to send out properly-qualified teachers to spread real instruction in music, the art above all others which has the power of refining, elevating, and civilising those great masses of humanity which have at present no other means than is offered by the beershop or the gin palace of enjoying that intellectnal change of pursuit which is essential to the well-being of all classes."

CORRESPONDENCE.

SCIENCE TEACHING IN SCHOOLS.

Your readers are aware that a new step in primary education was taken last year by the School Board for London in supplying to their schools, at the suggestion of Dr. Gladstone, boxes of simple and extremely cheap apparatus, with appropriate instructions, for giving to object teaching a more impressive and fruitful character, rendering instruction in common things experimental as well as visual, and thus instilling early notions of scientific facts. It was in order to enhance, if possible, the value of this measure, by enabling the School Board teachers to follow up early initiation with a progressive development of useful knowledge, that I offered them an opportunity of hearing my "Science made Easy" course of ten lectures, delivered at the Cowper-street Middle-class Schools by Mr. Bower, a science master well qualified for explaining the manner in which the select information, classified and popularised in these lectures, should be progressively infused in the expanding minds of the children, less as a task, than as a recreation. The number of teachers of both sexes, who, in response to a programme circulated by the Board, applied for tickets to attend this free course, was over 450, and most encouraging was the earnest attention of the audiences, for which excellent accommodation was kindly provided by Mr. Wormell, M.A., head master of the Cowper-street Schools. Of over 50 candidates who inscribed their names for the examinations held at the conclusion

of the course, on the evenings of May 24th and 27th, only 20 presented themselves, but the creditable manner in which the great majority of these answered the questions selected for the occasion from the printed Questionary by the examiner, Mr. Wm. Hudson, B.Sc., F.C.S., showed that many of the absentees might probably have passed with ease. The answer-books of the first evening, embracing mechanical and chemical physics, and chemistry, and those of the second evening embracing natural history and human physiology, were brought home to the Twickenham Economic Museum by the examiner, who, after a careful scrutiny, proposed in his report that nine candidates should receive the certificate of competency, and eight the higher one of proficiency, and that to the latter should be awarded prizes amounting in the aggregate to £19. Dr. Gladstone, F.R.S., consented to preside at the distribution, which was held on the evening of the 19th inst., at the office of the School Board. The examiner opened the proceedings by reading his report, which he prefaced with a brief account of the manner in which I had been led, step by step, to the formation of a museum answering to the household and health requirements of the working classes, to the institution of elementary lectures on the sciences which minister to those requirements, and lastly, to the prospective diffusion of this practical knowledge among the rising generation of artisans through the medium of the primary teachers, whose success in acquiring the necessary special training, it was the purpose of this meeting to recognise and to reward. The report having been read, the distribution took place amidst general satisfaction, not a little enhanced by the honourable prominence attained by some of the female teachers. Dr. Gladstone, in an appropriate address, dwelt on the great value of simple elementary scientific instruction for all the children in primary schools.

My inability to be present, in consequence of infirm health, was communicated to the Chairman in the following letter:—"My dear sir,—Public attention has of late been drawn to certain cases in which specific subjects have been introduced into primary schools with perhaps more zeal than discretion, aiming at mental culture for its own sake, rather than at any direct and tangible benefit to be realised. I am therefore particularly anxious that it should be known that the materials for elementary teaching contained in my 'Science made Easy' course, have, apart from the development of the faculties, a distinct utilitarian purpose, that of training the children of the people to preserve their health, and husband their strength, to do their work cleverly, and to turn to the best account the resources at their disposal in whatever position it may please God to place them. Grafted on the knowledge of common things, which you have so successively mingled with the pastimes of an early age, the instruction I advocate is intended to be itself so entertaining as to relieve agreeably the study of the 'Three R's,' at the same time as it renders more obvious their prospective usefulness."

Should any of your readers desire further particulars of my views concerning the cautious and discriminating introduction of scientific instruction in elementary teaching, they can, on application to Mr. William Hudson, Economic Museum, Twickenham, receive copies of my "Suggestions for Developing the Elements of the Science of Daily Life in the Primary Schools of the People."

Thomas Twining.

Twickenham, July 21st, 1880

NATIONAL EDUCATION AND COLONIAL RESOURCES.

The vital national importance of the question submitted to the Council of the Society of Arts, in the *Journal* of the 23rd inst., by Captain J. C. R. Colomb, induces me to add a very urgent appeal to the one he has so forcibly addressed to the Council, that it should use its great influence in taking some steps in the direction he has indicated.

There is no country in the world, whose inhabitants ought to possess a better knowledge of geography than those of the United Kingdom, whose territory extends so far and wide in every quarter of the globe. But until a recent period, comparatively very little was done to remove the vast ignorance which prevailed among the masses of the people with regard to one of the most important branches of national education. I entirely agree with Captain Colomb, that it is a great defect in our educational system, that the children of those who are being taught at the public expense, should be instructed more in the "history, natural features, extent, resources, and government of foreign States, than of their own possessions."

Surely our national system should, above all things, include the best, and most authentic information in all these points concerning our magnificent colonies of Canada, the Cape, Australasia, and New Zealand; as well as of all those other splendid possessions which are comprised under the rule of the British Crown. The especial reason for the rising generation being most thoroughly instructed in this direction, is obvious from the striking fact (which is too often forgotten, or ignored) that our population is increasing in this country at the rate of nearly 400,000 per annum; and that the pressure of this vast increase with every decade is so great, that even under any conceivable circumstances of what is termed national prosperity, it must compel a large portion of the future population of these islands to emigrate, in order to support themselves and their families.

But every family that leaves the shores of the United Kingdom ought to go, as a matter of course, to some other part of British, and not foreign territory. I am persuaded, the bulk of them would do so, if they knew more than they do, and were better acquainted with the wonderful resources and large advantages of the colonies, instead of directing their steps, as for the most part they do, through want of knowledge, to foreign lands.

Frederick Young.

5, Queensberry-place, S.W.,
26th July, 1880.

GENERAL NOTES.

Noxious Vapours Bill.—Lord Midleton called attention in the House of Lords, on the 16th inst., to the report of the Royal Commission on Noxious Vapours, and to the Bill of 1879 (the provisions of which were discussed by Mr. E. R. Muspratt, in his paper read before the Society on the 25th February last). Lord Enfield, in reply, said that the recommendations of the Commissioners might be classed under four heads:—First, the amendment of the alkali works; secondly, the extension of the alkali works; thirdly, the inspection of works not already dealt with—viz., arsenic, cobalt, dry and wet copper works, galvanising, glass, lead, nickel, salt, spelter, tin-plate, with certain other works—these works to be inspected and an annual report to be made to the Local Government Board; and, lastly, the improvement of procedure for recovery of damages. He also expressed a hope that the President of the Local Government Board would be able to introduce early next Session a measure to carry out the recommendations of the Royal Commission.

The summer meeting of the Institution of Mechanical Engineers will be held at Barrow-in-Furness, from Tuesday, 3rd, to Friday, 6th August.

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FRIDAY, AUGUST 6, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

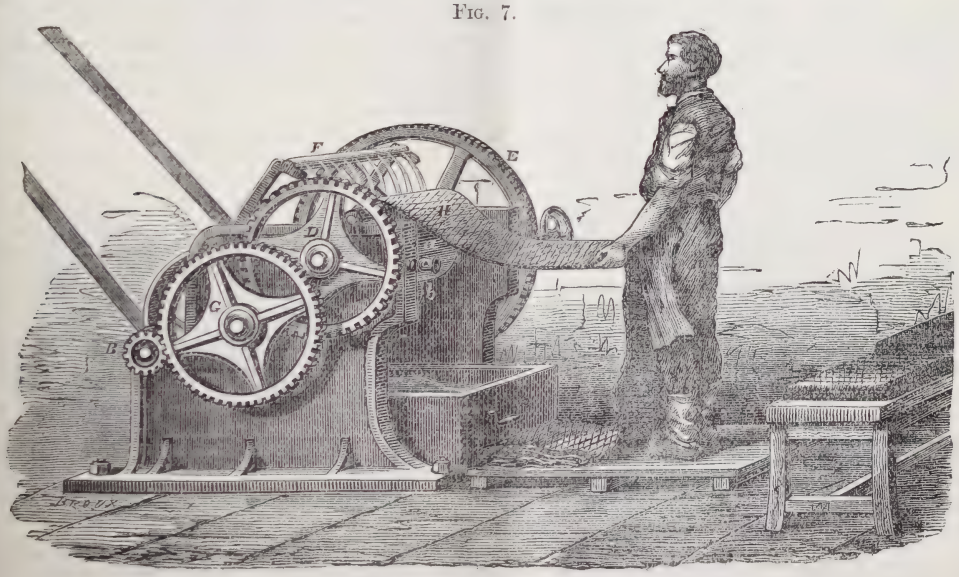
By Thomas Bolas, F.C.S.

LECTURE II.—DELIVERED FEBRUARY 9, 1880.

Mechanical and Chemical Purification of India-rubber. Working of Unvulcanised Caoutchouc. Formation of Blocks, Sheets, and Threads—Elastic Webbing. Other uses of Unvulcanised India-rubber.

The first step in the industrial purification of the raw caoutchouc consists in boiling the crude material in water for some hours; and during this process the caoutchouc becomes so far softened that it can be easily cut into slices by means of a knife. In actual practice, large covered rectangular tanks are employed, steam being injected in order to keep the water at a boiling temperature. The operation is imitated, for the purpose of illustration, by the arrangement you now see on the table. The water in this glass vessel having been kept boiling by means of steam during the last two hours, these lumps of raw caoutchouc are tolerably well softened; and you will notice that the india-rubber has become whitish from the absorption of water. This particular lump has most likely absorbed as much as fifteen or sixteen per cent. of water. The softened lumps are next cut up into thickish slices by a long sharp knife, and during this operation, the workman throws aside any stones or large particles of foreign matter with which he may meet. A pair of rather large even-speeded rollers are next brought into requisition to crush the slices of softened rubber. These rollers work in the same horizontal plane, or nearly so, and are fluted on the face by a series of deep spiral grooves, diamond-shaped projections being left between these. During the operation of crushing the india-rubber, a stream of water is kept running on it, this water being generally hot in the case of the first crushing operation. The first pair of rollers reduces the caoutchouc into the form of a very rough and broken-surfaced sheet, from which many of the mechanical impurities have been removed by the crushing action of the rollers and the rinsing action of the water. The very rough sheet produced, as above described, and of which a sample is before you, is again washed by means of a somewhat similar, but smaller, pair of rollers, cut on the face with a much finer diamond-shaped pattern, and this washing is continued until all mechanical impurities are worked and washed out of the rubber. Here are some samples of "washed sheet," and you will notice the peculiar broken surface which it presents, while by looking at it in certain lights, you will be able to trace out the diagonal pattern imprinted by the rollers. The engraving which I now project on the screen will give you some notion of the operation of washing india-rubber on a large scale (Fig. 7), and I will now show you a diagram illustrating the manner in which the surface of a washing roller is cut (Fig. 8). The cuts are made from $\frac{1}{4}$th to $\frac{1}{20}$th of an inch apart, according to circumstances.

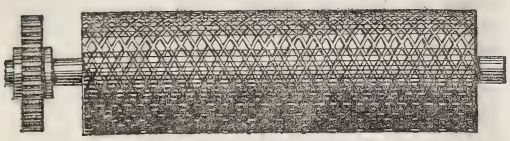
FIG. 7.



WASHING OF CAOUTCHOUC.

The next thing is to illustrate practically to you the operation of washing. Here is a pair of fluted rollers, and on passing some of the slices of

Fig. 8.



Roller of Washing Machine.

softened rubber through them a few times, you see that the impurities are washed away by the stream of warm water flowing from above, and the rubber is agglomerated into a kind of rough, irregular sheet, which I will pass round for your inspection.

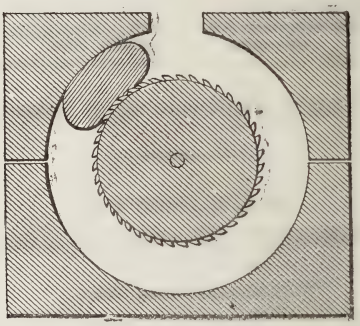
The completeness with which solid impurities are removed from caoutchouc by the operation of washing is, at first sight, surprising; but it must be remembered, that as soon as the tearing action of the rollers enables water to penetrate between any foreign body and the india-rubber, this body is in a fair way to be carried off by the stream of water. The rubber, as it leaves the washing rollers, contains a considerable amount of water locked up in its pores, and in order to remove this, the washed sheet is taken to a stove or drying room, where it is hung up until all moisture has evaporated. A considerable loss occurs during the operation of converting the crude india-rubber into washed sheet, this loss occasionally amounting to over one-third of the original weight of the material; and the following Table, which is extracted from a series of excellent articles on india-rubber and gutta-percha, which have recently appeared in *The Universal Engineer*, will give some notion as to the average loss which various qualities of caoutchouc are subject to :—

Quality of Caoutchouc.*

	Loss by Washing.
Para	15 per cent.
Negrohead	25 ,,
Guayaquil	40 ,,
Borneo	25 ,,
Ceara	28 ,,
African Ball	25 ,,
African Nigers	25 ,,
Madagascar	25 ,,
African Tongue	35 ,,

The washed sheets of india-rubber, considered as sheets, are of no practical utility, for they are irregular and full of perforations, but the washed sheet rubber is the starting point as regards most of the further developments of the rubber industry. By the operation of mastication, the washed sheets are worked up into compact homogeneous masses. The masticating machine, invented by Thomas Hancock, consists of an internal cylinder of metal, which revolves in a cylindrical iron casing. The india-rubber to be masticated, being placed between the rotating cylinder and the outer casing, becomes subjected to a very powerful mixing and grinding action, which ultimately reduces the india-rubber to a long solid lump, something like a sausage. Here is a model (Fig. 9) intended to illustrate the action of the masticating machine; and, if I introduce a little washed sheet india-rubber, previously softened by a gentle warmth, and get Mr. Barker to turn the handle, you will soon see that it is reduced to a compact form by the continual rolling and kneading action of the machine.

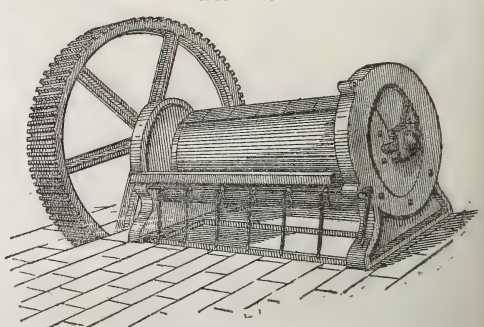
Fig. 9.



Section of Model used to Illustrate the Action of Masticating Machine.

The masticating machines employed in actual practice are large and heavy, being often capable of working as much as 200 lbs. of caoutchouc at a time. The diagram now shown on the screen (Fig. 10) represents the masticating machine as constructed at the present time, but the upper quadrant of the outer casing, which is represented as being open, is, during the working of the machine, partially or completely closed by a series of curved iron plates or doors, which can be clamped down into position by the levers shown at the lower part of the diagrams. The weight of these doors or traps is balanced by a series of counterpoises, so that the apparatus can be opened with facility. The central cylinder is fluted, so that its section would represent the appearance of a circular saw (Fig. 10), and water-way passes through it axially, so that the great heat produced during the mastication of the india-rubber may be moderated by a stream of cold water.

Fig. 10.



The Masticating Machine.

During the progress of the operation of mastication, which may last from four to five hours, the sausage-like block is occasionally cut in half, and

* L'ingenieur Universel : The Universal Engineer. Diglot Journal, Manchester, 14, Oxford-road. Vol. II., page 187.

the pieces are replaced in the machine in a reversed direction. Here is a piece of one of the masticated blocks, and if you examine this section of it you will see how very uniform the texture of the material has been rendered by the operation of mastication. The masticated rubber is generally converted into rectangular blocks by being forced into iron boxes, it being previously softened by subjection to the heat of steam at a moderate pressure. When thoroughly cold and set, the blocks are removed from the iron moulds. The rectangular blocks thus obtained are largely employed for the manufacture of the "fine-cut sheets," which sheets are extensively used in the fabrication of various small articles of caoutchouc. In order to cut these blocks into sheets, the block to be operated upon is fitted into a box attached to a sliding arrangement, like the bed of a planing machine. As the block is led forward by the mechanism, a slice is taken off by a sharp knife, which moves to and fro at the rate of two thousand movements per minute, this knife being kept wet by means of a stream of water. The outer sheet having been cut off, the block is raised in its box to an extent corresponding to the required thickness, and the operation of cutting is then again performed; the raising and cutting being now repeated until the whole of the block has been divided into sheets. The feed of the block up to the knife is generally at the rate of about one inch for each 60 cut, as one may perceive by counting the ribs on an ordinary piece of cut-sheet rubber. Occasionally, sheets are cut from cylindrical blocks, the block being made to revolve slowly on a kind of lathe, while a rapidly moving knife, attached to a rest, cuts the cylinder into one continuous sheet; but the method in question does not appear to find much favour in this country.

On the table you will find a very complete collection of specimens illustrative of the processes I have alluded to, these having been kindly lent by the Silvertown Company, Mr. Bell, Messrs. Tuck and Co., Messrs. Anderson, Abbott, and Anderson, and others. In the case of these coloured cut sheets, pigments are incorporated with the caoutchouc. The pigments are best incorporated by means of the mixing rollers, which will be described in the next lecture, the coloured rubbers being then masticated; but the masticating machines may be used for the incorporation of solid matters with the caoutchouc.

During mastication, the india-rubber undergoes a remarkable deterioration or degeneration, especially as regards its fibrous or insoluble constituent. India-rubber during a thorough mastication loses much of its elasticity and strength, and either dissolves perfectly in cold naphtha or forms something which is remarkably like a true solution. To illustrate the difference in this respect, between unmasticated rubber and that which has been masticated, I will put a slice of raw Para rubber, and a similar slice of masticated Para rubber, side by side in a bottle of coal naphtha. The former will swell, but retain its form, while the latter will dissolve in the course of a few days.* This kind of deterioration, due to masticating, renders the rubber eminently fit for the manufacture of the solutions, or pastes employed in making waterproof textures, or for other purposes; and the superior qualities of masticated rubber for the preparation of solution were fully recognised by Hancock, when the rubber industry was in its infancy. Although mastication alters the fibrous, or insoluble constituent, in such a way as to make it approximate in its nature, to the soft, or viscous constituent, there is always a notable distinction between the properties of a high quality of rubber, altered by prolonged mastication, and a low class rubber, such as African tongue.

Threads for elastic webbing were formerly cut from blocks of unvulcanised rubber; or even from the raw Para caoutchouc itself, this latter course being adopted in order to avoid the deterioration due to working or mastication. In the present day, however, vulcanised india-rubber is almost exclusively employed for the manufacture of threads intended for use in making elastic webbing. Notwithstanding this, what little I have to say regarding the cutting of threads I will say now, as the manipulatory details are not affected by the vulcanisation or non-vulcanisation of the rubber. Much ingenuity and skill has been expended on machines for cutting india-rubber into threads, and several systems have been employed. Sometimes, for example, a tube is converted into a single length of thread by one spiral cut; and in other cases a long sheet or strip is divided into a number of threads by means of a set of revolving knives. Here is such a set of knives, and I will first illustrate their action to you by cutting up a strip of sheet rubber, and then I will hand round the set of knives for your inspection. The sheets from which threads are cut are usually spread sheets, the nature of which will be explained in a future lecture, although calendered or rolled sheets are sometimes employed. The excess of the sulphur employed in vulcanising the rubber is generally removed by boiling the threads in a six and a half per cent. solution of caustic soda, for a period varying from quarter of an hour to one hour.

On the table you will find a selection of threads, and of webbing, manufactured from them; some of these threads being so fine that eight thousand yards only weigh one pound.

India-rubber threads have some industrial uses of interest, apart from their employment in the manufacture of elastic webbing. They are, for example, employed instead of weights in the Jacquard loom; as many as three thousand being occasionally used in one of these marvellous pieces of mechanism.

Here is a pretty little toy, depending for its action on a wound-up spring, formed of a thread of caoutchouc. When released, this spring actuates two vanes, arranged like the blades of a screw propeller, and away the thing flies, right over your heads, and it continues to fly about until the force stored up in the spring becomes exhausted. Perhaps we may here have the germ of a flying machine.

Later on in the course I shall have occasion to refer to the production of india-rubber threads by the process of squirting, this mode of procedure consisting of the forcing of softened caoutchouc through a die or hole.

A very large number of small articles, such as

* At the following lecture the bottle was shown. The raw rubber was intact, while the masticated sample had dissolved, with the exception of some traces of flocculent matter.

surgical goods, tobacco pouches, tubes, and so forth, are manufactured from the cut sheet rubber, and on the table you will find a considerable assortment of such articles, which have been lent by the firms previously mentioned.

The manufacture of such articles of cut sheet can best be illustrated, for lecture purposes, by a demonstration of the process of making the air balloons which are such favourite toys with children, and which are also extensively employed, especially in Paris, for advertising purposes. Mr. Dugwell, of New-road East, has kindly brought me a very extensive selection of these balloons and of the appliances used in their manufacture, while Messrs. Anderson, Abbott, and Anderson, of Queen Victoria-street, have provided me with some india-rubber balloons of an unusually large size.

Here, then, are some pieces of cut sheet rubber, and I will rub some French chalk on one side of each sheet. The next step is to arrange the sheets in pairs; the chalked surfaces being placed together in each case. In the next place, the outer surfaces of each pair are moistened with water, and the pairs are piled up together like the sheets of a quire of paper—eight pairs being super-imposed in the present case. Here, then, is a steel punch, capable of cutting out a pear-shaped piece, corresponding to the uninflated balloon, and you see that I now punch pieces out of the pile of sheets. The moistened surfaces readily separate from each other, and the result is a number of pear-shaped pieces of rubber, each of these being formed of two sheets, French chalked over the surfaces, which are in contact, and slightly adherent round the newly-cut edges. In the next place the sheets are separated at the part corresponding to the neck of the balloon. At this stage the uninflated air-ball may be considered to have had its first form given to it, but the newly-cut edges are very imperfectly adherent, only the extreme and inner angles of these being in contact; the major portion of the newly-cut surfaces being exposed to view round the edges of the punched-out pieces. A rather thin solution of india-rubber in benzole is now painted around these raw edges in order to make them more adhesive, after which the centres of each of the two pieces of sheet rubber composing the balloon are pulled out by the finger and thumb of either hand. This operation brings the adhesive edges of the balloon into perfect contact; they adhere, and the balloon is finished as far as construction is concerned. It is, however, usual to slightly vulcanise articles which have been manufactured from the cut sheet rubber, in order, not only to give them increased elasticity and strength, but also to protect them against the influence of cold, heat, grease, &c. Several methods of vulcanisation are available for this purpose, and these will be discussed in the next lecture, but for the present I will just show you how the balloons can be vulcanised by a momentary immersion in bisulphide of carbon, containing a very small proportion of protochloride of sulphur, one-fourth of a per cent. being sufficient for this purpose; although two and a-half per cent. is a usual proportion for general work. The above is the well-known cold-curing process introduced by Parkes. After dipping, the balloons are dried by a gentle heat on a tray covered with French chalk. They are now ready for inflation, and you see that Mr. Dugwell is busily engaged in the operation of inflating a number of those balloons which he has brought with him, and he intends to give each one of you an opportunity of taking away one of them.

Fig. 11.

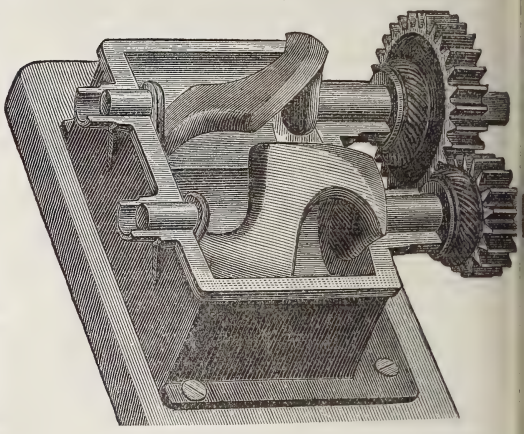


Fig. 12.

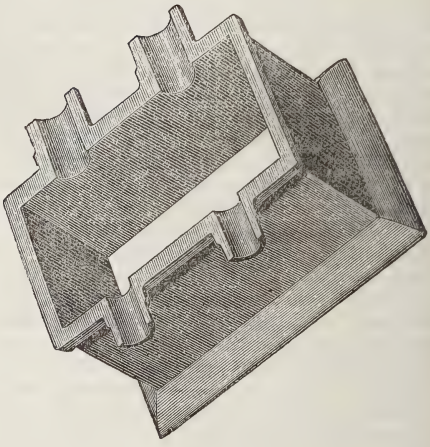


Fig. 13.

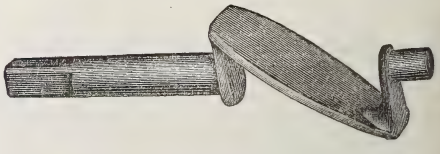
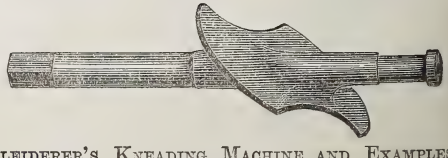


Fig. 14.



Pfleiderer's Kneading Machine and Examples of the various Mixers.

The manufacture of other articles out of unvulcanised cut sheet is so analogous to the making of the air balls, that I need not specially illustrate the processes; but I may mention, that although these articles are generally vulcanised by the cold process after they are made, the vulcanising action is principally confined to the surface, so that these partially vulcanised articles are more or less liable to become rigid by the action of cold.

Solutions of india-rubber have very many important uses, and they may vary in consistency from stiff pastes to limpid fluids, according to the proportion of rubber, its condition, and the nature of the solvent employed. A pasty solution or dough, containing about 20 per cent. of masticated rubber, dissolved in or incorporated with benzole or coal naphtha, is used in the industrial arts for a variety of purposes. It is employed extensively as a cementing material, and answers very well as a mounting medium for photographs, or for the repair of certain articles of india-rubber, while a textile fabric can be rapidly and easily rendered waterproof by being imbued with this substance. Such a paste or solution is usually prepared by allowing the rubber to swell in the benzole or solvent, and then kneading the product by means of a suitable machine. A very excellent apparatus for this purpose is the kneading and mixing machine invented by Mr. Pfleiderer. One of these ingenious machines is in action on the table, and by its side is a set of the variously formed mixers which are sent with the apparatus (Figs. 11, 12, 13, 14).

By the evaporation of a solution of india-rubber in such a solvent as carbon disulphide or chloroform, a very delicate and pure film of caoutchouc may be obtained; and here is such a sheet of rubber, prepared by allowing the solution to dry on a levelled glass plate. Mr. Forster, of Messrs. Cow and Co., has utilised this principle in the production of india-rubber gloves, of extreme tenuity and uniformity of thickness. These gloves are formed by repeatedly dipping a kind of last, or mould, into a solution of rubber, and vulcanising the film left on drying, by means of the cold process. By repeated operations, any required thickness of rubber can be built up. These gloves, some pairs of which I will hand round for inspection, are so thin, that a surgeon may wear them while performing an operation, in order to protect himself from possible blood poisoning; or a photographer may employ them to prevent the staining of his hands by the salts of silver which he employs.

Unvulcanised caoutchouc is employed in the fabrication of the valuable cement, known as marine glue, this being made by melting together one part of india-rubber, previously softened by, or dissolved in coal naphtha, and two parts of shellac.

MISCELLANEOUS.

PANDERMITE: A NEW BORACIC MINERAL.

By C. G. Warnford Lock.

Borax (bi-borate of soda) is one of the most useful and valuable natural salts, and a sufficient supply of it is essential to the existence of an important manufacture—pottery, besides being eminently adapted to many other uses. The production of borax has long been inadequate to the demand, and has favoured the utilisation of native boracic acid, and borates of lime, of magnesia, and of lime and soda. Our markets are at present supplied from distant and diverse sources. Borax comes principally from Tibet, and other trans-Himálayan territories, on the one hand, and from California on the other; with very small occasional contributions from Peru and Chili. Boracic acid is commercially produced only in Tuscany, and is consumed chiefly in Continental Europe. Borates of lime, and of magnesia, have not hitherto been shipped in any quantity to this country. All these products I have described at length in the article, "Borax," in "Spon's Encyclopædia." I have now to deal with a new commercial borate, which, on the score of geographical position, abundance, cheapness of working, and easy manipulation, is certainly destined in a great measure to rule the markets of Europe, and particularly of Great Britain. The new field lies on the Tchinar-sou, a small stream feeding the Rhyndacus river, whose outlet is in the Sea of Marmora, near the port of Panderma, on the Asiatic shore. It embraces the villages of Sultan-Tchair, Yildiz, and Omerli, and the guard-house of the Demircapon pass. The area of the field is computed at over 13,300 acres (20 square miles). Its eastern confine nearly abuts upon the Rhyndacus, which has been navigated by steamers up to a point called Balakeser. A company has been formed for deepening and improving the stream, and a railway has been projected from Panderma to Balakeser. The wagon-road has hitherto been utilised for transporting the mineral, the distance from Panderma to the western edge of the field being about 40 English miles. The port of Panderma is regularly frequented by local steamers, and offers every convenience for shipping.

The field is situated in a basin of Tertiary age, surrounded by volcanic rocks, which vary from granite on the east to trachyte on the north, and columnar basalt on the west; several basaltic hills and dykes protrude in different portions of the basin, and the presence of hot and mineral springs further testifies to the volcanic influences which have been at work, and in which, doubtless, originated the boracic mineral. The latter occurs in a stratum at the bottom of an enormous bed of gypsum, its greater specific gravity probably impelling it downwards while the whole mass was yet in a soft state. Several feet of clay cover the gypsum bed, which is here 60 to 70 feet thick, though in places it attains to double that thickness. The boraciferous stratum varies in depth: it has been proved for a vertical distance of 45 feet. The mineral exists in closely-packed nodules, of very irregular size and shape, and of all weights up to a ton. Von Rath has named it Pandermite, from the port of shipment. In outward appearance, it closely resembles a snow-white, fine-grained marble. Chemically speaking, it is a hydrous borate of lime, its composition being expressed by the formula $2\,Ca\,O,\ 3\,B_2\,O_3,\ 3\,H_2\,O$: in other words, it consists of boracic acid, 55·85 per cent.; lime, 29·78 per cent.; and water, 14·36 per cent. Its richness in boracic acid is at once apparent, and places it high above other commercial borates. Thus ordinary borax (borate of soda) contains only 36·58 per cent. of the acid; boro-calcite and boro-natro-calcite (borates of lime, and of lime and soda) vary from 8½ per cent. up to 46 per cent., and average about 40 per cent. Boracite and stassfurtite (borates of magnesia), containing respectively about 63 per cent., and 60¾ per cent., alone surpass it in this respect, and they can hardly be deemed commercial minerals. After very simple preparation, pandermite can be directly applied as a flux, and is more economical than borax for this purpose, thanks to its larger proportion of boracic acid.

An outcrop of the mineral was discovered by a foreigner some years since, and the bed was secretly worked; small shipments were occasionally made to

Europe, under the denomination of plaster of Paris, thus keeping the matter hidden, and at the same time avoiding the payment of dues and duties. The Ottoman Government has since been apprised of these irregularities, and has taken energetic measures to correct them. More recently, it has granted a comprehensive concession to a party of British residents, who are setting to work to develop the property. The district enjoys the great advantage of being under British protection. The workings were at first placed under that section of the *Réglement des Mines* relating to quarries, but have since been transferred to the section regulating mines proper. Steps are being taken to open up the deposit in a systematic manner, by first sinking a number of bore-holes—as has been done with the kainit beds at Stassfurt—to ascertain the points of greatest development in the basin. The locality possesses a healthy climate, except in the autumn, when there is some ague. Labour is very cheap and abundant, Turks, Circassians, Tartars, Armenians, Greeks, and Italians being obtainable from the neighbouring villages. There is a supply of water; oak and fir timber may be procured at six to seven miles distant; and scrub for fuel covers the surrounding hills.

The actual cost of the mineral, as now worked, is as follows:—

	Paràs per oke.
Raising and dressing (exclusive of cost of tools)	10
Transport to Panderma	9
Customs duty, 1 per cent. *ad valorem*	½
Management and other charges	2½
	22

	Per ton. £	s.	d.
At 795½ okes per ton, and 128¼ piastres per £ sterling (1 piastre = 40 paràs), this will equal	3	8	3
To this must be added Government royalty, 5 per cent. *ad valorem*, say	0	5	0
Contingencies	0	10	0
Freight and insurance	0	15	0
Making the total cost, "*c*, *f*, and *i*"	£4	18	3

The present values of the boracic products now in the market vary from £46 to £60 per ton, according to quality; the lowest figure ever reached has been about £20 a ton, at which price the demand would immensely increase.

LAND CULTIVATION IN SHIRAZ (BUSHIRE).

A village, with an area of land sufficient for sowing 18,000 to 20,000 maunds of grain (one maund being equal to 6½ lbs.) is valued at 60,000 krans, the krans being equivalent to 11¼d. Government taxation on such a village would be about 2,500 krans per annum, which is considered to be more or less reasonable. This area is divided into three parts, of which one part only is cultivated during the year, the other two being allowed to remain fallow, awaiting their turn for cultivation in subsequent years. The "shatwee," or autumn sowings for the year, in such a village, necessitate the outlay of seed in the following proportion:—Barley, 2,000 maunds, and wheat, 4,000; while the "saifee," or spring sowings are—for rice, 400 maunds; maize, 200; cotton, 200; and sesame, &c., 100.

The out-turn of "shatwee" sowing, is ten fold in a good year, and five fold in a bad one; rice, thirty fold during a prosperous year, and ten fold during an unfortunate one; maize, fifty fold during a good year, and twenty fold during a bad one. Irrigation may be natural, such as by rivers and springs, or artificial, by means of kanats. A kanat is invariably private property, appertaining to the village, and involving an annual expenditure of 500 krans to keep it in repair.

If the village happens to be irrigated by a river, the proprietor of that village has to pay his share of the watercourse leading to his lands; if irrigated by a spring, disputes very frequently arise on account of proprietors of other villages attempting to draw away more water than is their due. One village should entertain 40 ryots, irrespective of their families and strangers, and have 20 pairs of beasts of burden, or 40 oxen. The ryots find themselves altogether. The out-turn is divided into three parts—one-third for the ryots and two-thirds for the proprietor; if the proprietor should wish to bring his share of the produce to town, he must defray the expenses of the carriage. All taxes on the land and water are paid by the proprietor, the amount of which, in most cases, varies in proportion to his position, for he either manages to pay the taxes according to the ancient Government "toomar" (tariff), which is generally on a low scale, or contrives to lessen a certain amount from the new and higher rate of taxation, the deficiency in the latter case being burthened on the revenues of a neighbouring village, the proprietor of which may be less influential. Taxation on villages is very irregular, and, in most cases, extremely oppressive. Wealthy and prosperous villages, worth about 50,000 krans, are known to pay 300 to 500 krans a year, whereas smaller and less prosperous ones are subjected to a payment of 10,000 to 12,000 krans annually. In the latter case, the owner necessarily is a ruined man, and always in trouble with Government, whose officials are liberal with the bastinado and imprisonment for default of payment. Unless the proprietor is a really influential man, or a "moola," or a "mojtehid," it is not at all profitable to be a farmer in Persia. The difficulties experienced by a proprietor are as follows:—Want of protection against the robberies of the ryots; the heavy Government taxation; and the constant and false claims set up against the property. This last is a characteristic feature in Persia, especially as there is no law for the punishment of a false claimant. Many *bonâ-fide* landowners have been utterly ruined by these false claims, and they are always tolerated by the Government and priesthood, as it constitutes a sure source of income to them. The taxes are paid in kind on the "shatwee" sowings, and in cash on the "saifee" sowings.

There are two classes of ryots—one called the "ryot-i-padishah," who pay only "sarmardy," or poll-tax, and no change of residence, to however great a distance from his original place of abode, will exempt him from the levy of that tax. The other class pays no "sarmardy," but a sum of about 20 krans is annually taken from each ryot towards the maintenance of Government sowars, &c., but in many instances where the "kedkhoda," or the landlord, possesses any influence, this payment is successfully resisted, the actual taxation on the land and cultivation, however, being payable by the owner. The proprietor provides for the seed; labour during cultivation, up to collection, after harvest is undertaken by the ryots.

A "motesadee" (overseer) is entertained by the proprietor, receiving as his salary 3 per cent. on the produce. A "kedkhoda" is also appointed by the proprietor, taking 5 per cent.; this person is obliged to entertain the proprietor whenever he calls at the village, his expenses incurred for the occasional entertainment of the owner and his servants may amount to 30 tomans annually, one toman being equal to 9s. 3½d. A systematic spoliation is carried on by the ryots, both during the season for sowing and gathering in the harvest, and it is almost impossible for the farmer to check these robberies, or to ascertain the exact quantity of his harvest.

The agricultural instruments principally in use are the "khish" (plough), "borré" (a machine consisting

of sharp-edged discs, used for separating grain from husk), "aubsée" (winnowing-fork), "daus" (sickle), "khooré" (sack), "beel" (spade), two or three sieves, "jawal" (pannier), and ropes. A supply of at least 50 krans worth of implements being required for each "gao" is furnished by, and appertain to, the ryots. Two hundred krans may be taken as an approximate estimate of the annual expenses of a ryot and his family; in no case does the value of his furniture, consisting of copper utensils, a couple of inferior carpets, a few earthen jars, beer or soda water bottles, exceed 20 tomans.

A proprietor is often obliged to construct a wall round the village, with a gate and a tower or two. The ryots build their own quarters, and at their own expense. Each ryot invariably undertakes a small amount of cultivation on his own private account, which is called "khássee," and in which the proprietor has no share whatever.

TRADE OF INDIA.

The following corrected figures of the trade of India for 1879-80 have been received, and are compared with those for the three preceding years:—

	1876-7.	1877-8.	1878-9.	1879-80.
Imports:—	£	£	£	£
Merchandise	35,367,177	39,326,003	36,566,195	39,733,710
Treasure	11,436,118	17,355,460	7,056,748	11,654,895
Total Imports	46,803,295	56,681,463	43,622,943	51,388,605
Exports:—				
Merchandise	60,961,632	65,185,713	60,893,611	67,168,861
Treasure	3,942,580	2,155,136	3,895,545	1,928,828
Total Exports	64,904,212	67,340,849	64,789,156	69,097,689
Total Private Trade	111,707,507	124,022,312	108,412,099	120,486,294
Excess Exports of Merchandise	25,594,455	25,859,710	24,327,416	27,435,151
Excess Imports of Treasure	7,493,538	15,200,324	3,161,203	9,726,067
Net Excess Exports of Private Trade	18,100,917	10,659,386	21,166,213	17,709,084
Net Excess Imports, including Government transactions	16,167,038	8,613,679	20,062,399	16,427,858

It may be interesting to compare with the surplus exports the amount of Council Bills drawn on India, taken, for the sake of uniformity with the trade figures, at the nominal rate of 2s. the rupee:—1876-7, £14,857,512; 1877-8, £11,698,500; 1878-9, £16,912,361; 1879-80, £18,350,000.

Taking the four years together, the excess exports aggregated £61,270,974, and the Council Bills £61,818,373, being thus nearly equal. It may be noticed that imports of cotton goods recovered from the depression from which they had suffered in the previous year, the figures being—1877-8, £20,172,716; 1878-9, £16,906,556; 1879-80, £19,652,548; while exports of raw cotton showed a great advance, as follows:—1877-8, £9,383,534; 1878-9, £7,913,046; 1879-80, £11,146,503. The value of opium exports was—1877-8, £12,374,355; 1878-9, £12,993,979; 1879-80, £14,323,314. In wheat there was some recovery—1877-8, £2,856,990; 1878-9, £513,778; 1879-80, £1,121,014; and in jute a continued expansion — 1877-8, £3,518,114; 1878-9, £3,800,426; 1879-80, £4,370,032. Exports of tea declined—1877-8, £3,044,571; 1878-9, £3,138,423; 1879-80, £3,051,020. While the quantity of tobacco exported declined from 13,723,660 lbs. to 11,412,095 lbs., the value rose from £126,322 to £129,810. The quantity was about the same as in 1877-78, but the value greater by £36,000.

GREENWICH OBSERVATORY.

The last report of the Astronomer-Royal to the Board of Visitors (June 5, 1880) contains the usual account of the present state of the Royal Observatory, divided under 17 heads. The printing of the observations has been for some years gradually falling more and more into arrear, but arrangements have now been made for accelerating the rate of printing, and it is hoped that eventually the volume for each year may be completed before the end of the year next following. The calculations of the Transit of Venus, 1874, are being proceeded with, and 128 pages of the observations are now in type, which contain the text and the greater portion of the tabular part of the Honolulu work. Sir George Airy concludes his report with the following general remarks:—"The determination of places of stars, sun, moon, and planets was handed down to me from my predecessors; it has in various ways been much extended. The magnetic and meteorological observations (the first originating with myself, the second partly with the movement introduced by the Royal Society, and partly with myself) constituted a distinct branch of science, having this property in common with the original astronomical work, that it is incessant and regular. The much later introduction of photographic and

spectroscopic astronomy, established at the instance of the Board of Visitors, and carried on with vigour and regularity, has created a third department. All these departments appear, at present, to be working efficiently and well. But I can easily imagine circumstances which would interfere materially with the successful continuation in one place of this triplicate series of observations. Though I think this possibility of partial failure worthy of the contemplation of the visitors, yet I do not see any necessity for action of any kind at the present time."

LONDON WATER SUPPLY.

The following proposal to supply the metropolis with water from Bala Lake, in North Wales, has been submitted to the Secretary of State for the Home Department by Mr. J. W. Welborne for consideration by the Committee of the House of Commons now sitting:—

The water of Bala Lake has been carefully tested and proved to be equal in purity to the water of Loch Katrine, and ample in quantity for the supply of the metropolis. It is also probably sufficient for the towns *en route*. The country adjacent is sparsely populated, and a few mountain sheep and grouse constitute the occupants of the surrounding hills, hence there is a minimum of possible pollution. The rainfall registered at Bala for the year 1876 was 52·69 inches, which is about the average rainfall there. The lake is nearly four miles long by three quarters of a mile wide, covering 1,100 acres. The water-shed of the district contains 35,392 acres, or 55 square miles, this with the Bala register of rainfall would, after deducting 10 per cent. for absorption, give 37,040,000,000 gallons per year, or 104,000,000, per day. But inasmuch as Bala lies on a level with the lake, the register of the rainfall there does not represent the rainfall of the district. On the surrounding mountains the rainfall is probably twice as much as in the valley, which will leave a large surplus for supply, after giving compensation to the river.

The lake is 553 feet above Trinity high mark, and 300 feet above Stanmore, where it is proposed to make the reservoirs. By embanking the lake 5 feet, and drawing down 2 feet below the present level, sufficient water can be impounded to supply 104,000,000 gallons daily, for thirty-seven days without any rainfall. Should further supply be required 50,000,000 gallons per day can be obtained from the River Vyrnwy which is situated on the lines of route to the metropolis.

It is proposed to convey the water from Bala through a series of iron pipes sunk to a depth sufficient to protect them from the action of the frost, along the sidings of the Great Western Railway to Stanmore, where the reservoirs should be on a scale adapted to provide for a storage of water equal to forty days' supply. These should consist of one or more large reservoirs and ten smaller ones. The large reservoirs would be capable of holding three thousand million gallons, or 30 days' supply, and would be lined with brick or stone. The ten smaller ones, lined with white glazed brick, would each be calculated to contain 100 million gallons. The space required for those reservoirs would be 500 to 600 acres, for the large ones according to depth, and 25 acres for each of the smaller ones. The water would be delivered into the large reservoirs as pure as its source, thence it would pass through a system of filtration of approved character into the smaller reservoirs in a condition of absolute purity. These reservoirs being 250 feet above the Bank of England, the water on reaching London would be conveyed through the existing mains of the water companies at high service level.

General Remarks.

Had Bala Lake existed at Stanmore instead of North Wales, it would, doubtless, long ago have formed the source of the London water supply. If it is approved as a source of supply, it is simply an engineering question how to convey the water for the use of the metropolis free from pollution in the most effectual and economical way. By adopting the sidings of the Great Western Railway as the route, the following advantages would be obtained.

1. The right of way for almost the entire route would be secured by one negotiation.

2. Land otherwise of no value would be utilised without detriment either to it or to the property of the railway company.

3. All the plant required would be delivered by the railway company at the places where it would be laid.

4. The telegraph system would be available in case of any accident to the pipes.

5. There would be great saving in the time required for the construction, and also great saving in the cost.

By making the reservoirs at Stanmore a sufficient level would be obtained to supply the high service to London without pumping, the cost of which, at present with filtration, is about £100,000 (one hundred thousand pounds) per annum. By the use of white glazed bricks for the lining of the smaller reservoirs facilities for quickly and thoroughly cleansing them would be obtained. In short, pure water would be delivered from them as from a china basin.

SAPPHIRE MINES OF SIAM.

The commercial report by the acting British Consul General in Siam for the year 1879, quoted in the *Pharmaceutical Journal*, contains the following information upon the sapphire mines:—

The year 1879 will long be memorable in the province of Battambong and Chantaboon for the discovery of valuable sapphire mines and for the great influx of foreigners, chiefly from British and Independent Burmah, to work them. There have long been mines of inferior value in this neighbourhood, and about five years ago new mines were discovered by a native hunter. Being, however, in a very remote and secluded position it was some time before the fame of the new mines spread to the Burmah and Indian gem traders and miners. Some individual diggers, however, having found their way to the mines, and having returned to Rangoon and Calcutta with the proceeds of their work, realised very large sums, and a rush for the new mines commenced and continued throughout the last year, during which many thousands of British subjects passed through Bangkok from British Burmah on their way to the mines. The arrival of these large bands of armed strangers caused considerable alarm among the natives of Chantaboon and Battambong, who could scarcely be persuaded that the country was not invaded once more by the old hereditary enemies of Siam, the Burmans and Peguans. The miners, however, by their peaceable behaviour restored confidence, and the country people soon were glad to sell them all kinds of provisions at enhanced rates.

The miners, in their haste to become rich, disregarded all considerations of health, and immense numbers died from jungle fever. The Toung-thoos from Pegu proved the most capable of standing the climate, and, many having made money and returned successful to their homes, the rush continued unabated for a long time, but now the great mortality is beginning to tell, and the broken health and emaciated appearance of most of those who return will check the eagerness of others to try their fortunes in this fever-stricken district.

The governor of the province has hitherto levied 2 ticals (5s. 7½d.) from every man working at the mines, and this is cheerfully paid. Good order has hitherto

been maintained, and the governor has appointed a British subject, named Kam Sai, to act as headman and to collect the licence duty.

The Siamese authorities do not regard with entire complacency this conveyance from their soil of these valuable gems without payment of royalty. No definite proposition has, however, yet been made to impose any other than the licence tax above mentioned. There would propably be found considerable difficulty in collecting any sort of *ad valorem* duty. As it is, the iscovery of the most valuable stones is kept as secret s possible by the fortunate finders, and should any *l valorem* duty be attempted to be imposed, the tax-gatherer would probably be defeated by craft or force.

One of the miners who was in Bangkok on his return from the diggings, a poorly-clad and miserable looking individual, on being applied to, produced a few small stones, and, after a great deal of coaxing, was induced, with many precautions, to give us a private view of his great prize, which was a very large sapphire in the rough, which he valued at 20,000 rupees. He would probably not have shown this stone at all had he not been on the point of leaving in a steamer. Owing to the secrecy thus observed by the possessors of valuable gems, it is impossible to give any estimate of the total value of stones found, but that individuals have made very large profits is certain. There is a man now in Bangkok who dug out a stone which he offered for sale in Chantaboon at 1,000 rupees, but did not find a purchaser. He went with it to Rangoon, where he was offered 15,000 rupees; but, having then awoke to the value of the stone, he declined to sell and took it to Calcutta, where he eventually obtained 30,000 rupees for it. Now, however, there are many experienced gem merchants established in the neighourhood of the mines, and something like the real value of the stones can be obtained by the miners on the spot.

Many of the miners finding themselves in cash have invested in the luxury of wives taken from the Siamese population, and the value of marriageable young women, who are at all good looking, has in consequence gone up to a very high figure.

The largest sapphire hitherto found, which I know of, weighed 370 carats in the rough, and when cut turned out 111 carats of the finest water. The ruby, onyx, and jade, are also found in the district, but the quality of none of these is such as to make them very valuable.

RUSSIAN SURVEYS IN THE BALKAN PENINSULA.

The geodetic and astronomical operations carried on by the Russians in the Balkan Peninsula, which in 1877 and 1878 covered the central part of Bulgaria and Roumelia, were in 1879 extended eastward as far as the sea, and west over the Rhodope mountains, as well as along the new Serbo-Turkish frontier to Novi-Bazar. A trigonometrical network thus now covers Bulgaria and Roumelia as well as a part of the Turkish territory. On the Serbo-Turkish frontier a strip 30 versts broad, and from the Bulgarian boundary to Novi-Bazar 175 versts long, has been triangulated. Over 150,000 square versts, 1,300 points have been fixed as sure bases for a special topographical map of Bulgaria, Roumelia, and Turkey from San Stefano in the south upwards. The goedetic network is connected both with the Russian meridian measurements and the Austrian Survey. The calculations are not yet completed for all points, yet the leader of the operations, Colonel Lebedew, has put together a relief of the Great Balkan from the sea to the Servian boundary, and the Little Balkan, with ts offshoots, to the valley of the Maritza. From this t is seen that the crest of the Balkan, from the Black Sea to Kotel, is nowhere more than 3,000 ft. above the sea level; from Kotel to the meridian of Selwi it rises from 3,500 ft. to 4,900 ft.; further to Zlatitza it has nearly everywhere a height of from 5,600 ft. to 6,300 ft., its highest point rising to 7,000 ft.; the last section, from Zlatitza to the Servian frontier, has a height of from 4,900 ft. to 6,300 ft., without any very prominent summit. The highest point of the Balkans, the Jümrüktschal, 7,830 ft. high, lies 12 versts north of Karlovo (1,260 ft. above sea level). The Rhodope mountains are mostly 5,600 ft. above the sea, the highest point not exceeding 7,000 ft. The Rilo mountains exceed the Balkans in height, their three highest points, Oleni Wrch, Popowa Schapka, and Segmentski Wrch, rising to more than 8,400 ft. above the sea. Mount Witosch, isolated over the plain of Sofia, rises over 7,000 ft., and stands only second to Jümrüktschal in the Balkans. In general the surface of the Balkan Peninsula rises in the direction from the Black Sea towards the west very considerably, so that, *e.g.*, the valley of the Isker at Samakow, 3,360 ft. high, lies higher than the crest of the Balkans between the Black Sea and Kotel. To the network of telegraph observed places have been added in 1879 over 20 astronomically observed points, so situated that they form with the fixed points of 1877 and 1878 four circles, which establish a reciprocal control over the operations. In Servia the position of Nisch has been ascertained, and will connect the operations with those of the Russians by means of the difference of longitude between Rustchuk and Kishinew. This year Colonel Lebedew will further ascertain the difference between Kishinew and Rostov, on the Don. On the topographical operations from 1877 to November, 1879, 100 topographers, divided into two main parties, were engaged. One, under Colonel Shdanow, completed in 1878-79 the east part of Bulgaria and Eastern Roumelia, 41,700 square versts; the other, under General Ernefeld, from 1877 to 1879, completed 82,350 square versts in these difficult western part and on Turkish territory in the Midia - Adrianople - Dedeagatch section. Along the boundary between Bulgaria, East Roumelia, Servia, and Turkey, a strip ten versts wide was measured in 1879. These boundaries run mostly at considerable heighths (over 5,000 ft.) from summit to summit, along the water-parting and mountain crest. The plates of the survey in Eastern Bulgaria were ready to be laid before the Russian Emperor on April 19; the sheets of West Bulgaria will be ready in November next. The maps will afterwards be published in heliography.—*The Times.*

PARKES MUSEUM OF HYGIENE.

A meeting of those interested in this institution was held on Tuesday, 27th July, at the Mansion-house, under the presidency of the Lord Mayor. The report stated that the museum was formally opened to the public on the 28th of June, 1879, by the then Home Secretary, and the first year had been one with which, in many respects, the committee had a right to feel satisfied. The museum at University College had been open to the public on three days in each week, and since the 1st of January, 1880, the number of visitors had been 2,166. During the past winter a series of demonstrations were given on Saturday afternoons by members of the executive committee. The first series was given for the benefit of the Working Men's Club and Institute Union, and comprised the subjects of house drainage, ventilation, lighting and warming, food, and the management of the sick-room. The second series was given to members of the Institution of Builders' Foremen and Clerks of Works, and comprised the subjects of ventilation and house drainage. Both series were numerously attended. The committee gladly entertained applications from persons engaged in tuition who might wish to bring

their pupils to the museum for the purpose of practical instruction. They trusted that the generous example of some of the City companies might be followed by others of the ancient City guilds and the wealthy citizens of London. The different sections of the museum had been considerably enriched during the past year, the only section which had shown no tendency to expand being that devoted to clothing, notwithstanding that the subject, in this variable and often trying climate, was one of prime importance. The provision of a new home for the museum had already become a necessity, and the removal of the collection to a building specially designed for it in some central position would prove a great benefit to the museum and a great boon to the public. As to the financial position, since the spring of 1876 £1,285 had been subscribed. Of that £641 had been expended in museum fittings, in paying the salary of a curator, and in other unavoidable expenditure. £600 had been invested, which yielded an income of something less than £24 per annum, and the treasurer had £65 in hand. The museum was free in every respect. No charge was made to visitors at any time, nor for space, suitability being the only condition for the acceptance of any object. Thus the museum was entirely dependent upon voluntary contributions. The executive committee were determined that the institution should remain a true museum, and not become a mere show-room for manufacturers and patentees. To achieve that object a permanent home for the museum must be found, and a sufficient sum provided to meet the annual expenditure. The committee confidently appealed to the public for the necessary funds. The adoption of the report was moved by Earl Fortescue, seconded by Mr. G. Palmer, M.P., and supported by the President of the College of Surgeons (Mr. Erichsen), and Mr. Erasmus Wilson, F.R.S.

PIASSAVA FIBRE.

Piassava fibre (better known as Bass) is found, writes Mr. W. Wigfall in the *Journal of Applied Science*, abundantly in South America, and is the fibre of some species of trees known as the "rope-bearing palm" of the Brazils, and hitherto chiefly obtained from the province of St. Salvador (Bahia). The fruit it bears is the brown coquilla nut used by turners. In the wet or rainy season the natives ascend these palms and strip the trunks and branches of their fibrous foliage. Snakes and other venomous reptiles often lurk in this flossy substance, and but for the gain it brings the natives it would be difficult to induce them to venture up amongst it. The branches being thus stripped, the fibre is thrown down to the ground, and then in a very primitive way the native proceeds to comb or hackle it through stakes or sticks driven firmly into the earth, thus drawing out the long and stronger fibres, and leaving the finer flossy substances behind their wooden hackle. This tow they prize for making into ropes, &c., and the coarse or strong fibres (which run from 9 to 10 ft.) they double in at each end to about 4 ft., and make up into rude bundles of about 14 lbs. weight, which (when they have secured enough of) they place on a sort of raft, and float it down the rivers a distance of 150 or 200 miles to the nearest sea-coast towns, some of which are Uná, R. Ilhéas, Point Segura, Santa Cruz, and others, and they sell or barter it away for food, chiefly "manioca," with a class of traders known as "manioca merchants," who give the poor natives a very low rate of exchange for their far brought produce. Manioca is a root not much unlike our English dahlia, which, when dry, is rubbed or ground down into a sort of coarse flour. The natives exchange their bundled piassava for this article of food.

These "manioca men" call themselves the "collectors and packers" of piassava in pressed bales for England, and latterly they have thought it expedient, by way of enhancing their profits, to introduce inside these bales (which they make up at from 1 cwt. to 2 cwt. each) large pieces of stone, old metal, mortar, sand, and huge logs of wood, in fact, anything to help the weight, and so adroitly do they manage this, that it is only when these bales are re-opened that their nefarious practices are found out. These packers bring their pressed bales to market in native craft or on small steamers plying along the coast down to the port of Bahia. There the bales are accepted by the merchants, and shipped to Liverpool and London for broom-making purposes; but to such an extent has this practice of introducing *débris* into the bales reached, that recently an influential meeting of piassava merchants and manufacturers was held in London, when it was resolved that communications should be at once entered into with the Government and merchants of Bahia requesting them to have all these pressed bales re-opened and examined before shipment to England, with a view of putting a stop to this imposition. The exports of this article last year from South America are said to have reached about £100,000 in value, and the local duty paid to the Brazilian Government is about 21 per cent.

The first introduction of Bahia piassava was some 38 or 40 years ago, when it came over merely as dunnage (packing) with cargoes of sugar in South American vessels trading between that country and Liverpool. This dunnage was mostly thrown away, as was also native piassava rope, as useless after a vessel had discharged cargo.

A Liverpool brushmaker seeing a lot of this apparently waste fibre in the docks, thought that it would make a good substitute for the ling and birch twig besoms then in use, and taking home a lot, he set about straightening it by steaming, combing, &c., and on chopping up the old castaway ropes into lengths he found that by boiling the fibres of which they were spun, they became straight and of wiry appearance, and so he applied them to broom-making for street purposes. It was not long, however, before the thing was taken up by others, and great improvements were made in dressing it.

At present large amounts of capital are embarked in the piassava trade, and it is computed that over 2,000 hands are employed in England alone in making street and stable brooms all the year round, besides employment afforded to large numbers in works where the fibre is merely prepared for the trade. The neighbouring countries of Germany, Holland, and Belgium, are steadily working into the piassava fibre trade as makers, while our Colonies of Australia, New Zealand, and the Cape are England's best customers.

GENERAL NOTES.

Proofs of Posting.—A deputation, introduced by Dr. Cameron, M.P., waited upon the Postmaster-General on Thursday, 29th July, to advocate Mr. Clifford-Eskell's proposed scheme of certificates of posting of unregistered letters (see *Journal*, vol. 27, p. 448). Mr. Fawcett estimated that the scheme would not be remunerative if only a farthing were charged for each receipt. He said, however, that he was "willing to give the scheme another trial, on the conditions he would name. These were, that the scheme should come into operation at the halfpenny rate on the 1st of January next in Glasgow. If it failed, it could not, of course, be extended, but if it met with only a portion of the success anticipated by the promoters he should be very glad to have been in any way the means of bringing within reach of the public any advantages they desired that department to supply."

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

LECTURE III.—DELIVERED FEBRUARY 16, 1880.

Vulcanisation of india-rubber. Chemical and physical aspects of the process. Incorporation of the sulphuretting material. Considerations on the use of combined sulphur rather than the free substance. Various methods of vulcanising. Effects of temperature and time. Destructive action of fatty oils on india-rubber.

Ordinary rubber, as before stated, retains its most characteristically useful properties through a very limited range of temperature; as a very moderate degree of cold on the one hand, or of heat on the other hand, suffices to render it valueless, as regards the major part of its industrial uses.

At 0° centigrade, caoutchouc is hard and rigid; while, at 100°, it becomes so soft as to become almost valueless as an elastic material. The consequence is that india-rubber, in its natural condition, has a very limited applicability in connection with the industrial arts.

The above-mentioned defects of india-rubber may be, to a most remarkable extent, removed by causing it to unite chemically with a small proportion of sulphur; and, not only does the sulphurised caoutchouc resist the effects of heat or cold, but it also refuses to dissolve in the greater part of those liquids which are solvents of the crude material. The credit of having originated the process of sulphurising or vulcanising caoutchouc appears to rest principally with Charles Goodyear, who laboured in the United States, and Thomas Hancock, who experimented in this country. In a patent, dated November 21, 1843, the last-mentioned gentleman describes in detail several of those methods of performing the operation of vulcanisation, which are in use at the present time; and he distinctly recognises the fact, that the over-vulcanisation of india-rubber leads to the production of a hard, black substance, resembling horn, this substance being now extensively used under the names of ebonite or vulcanite.

Let us now study the effect of sulphur on caoutchouc, by immersing some strips of the substance in baths of melted sulphur. Here, in the first place, is a cast-iron vessel, containing sulphur in a fluid state, and an inspection of the thermometer standing therein shows that the temperature of the bath is 120° Centigrade. A thin strip of caoutchouc is next partially immersed in the melted sulphur. Now, what is happening? The caoutchouc is absorbing the liquid sulphur, just as it would absorb benzole or coal naphtha; and the caoutchouc swells under the influence of the liquid sulphur, just as it did under the influence of the benzole, only the degree of swelling is far less in the case of the melted sulphur. I will now take out the strip of caoutchouc, and dip it into cold water. You see that the melted sulphur adherent to its surface has cracked up into innumerable fragments, and these are easily removed by a gentle friction on the surface of the rubber. Now, examine that portion of the caoutchouc which was immersed in the sulphur bath; it has become light yellow, and has, probably, now absorbed between 10 and 15 per cent. of sulphur. If, however, it had been allowed to remain in the sulphur bath (at 120° Centigrade) for a much longer period, it would have absorbed nearly half its weight of this substance. The caoutchouc which has thus absorbed sulphur differs, as regards elasticity, &c., but little from ordinary caoutchouc, because the sulphur is merely disseminated through its pores, and not chemically united. The india-rubber in this state is subject to the stiffening influence of cold, and dissolves in the ordinary solvents of caoutchouc. By the further application of heat, however, combination or chemical union of a portion of the sulphur with the caoutchouc may be caused to set in, and then the india-rubber becomes truly vulcanised. Now, then, let me put this strip of caoutchouc, which has already absorbed sulphur, into a bath of glycerine, heated to 140° Centigrade; and, if you examine it after the lecture, you will find it perfectly vulcanised. Instead of taking the strip of caoutchouc out of the sulphur bath, and placing it in a vessel of heated glycerine, it might have been allowed to remain for some hours in the sulphur bath, when true vulcanisation would have taken place, especially if the temperature had been slightly raised; but, in this case, the result would have been less satisfactory, as an over-large proportion of sulphur would have been absorbed. If, however, one commences the operation with a sulphur bath heated to 135° or 140° Centigrade, the vulcanisation of a thin sheet of caoutchouc may be completed in a few minutes. Here is a bath of liquid sulphur heated to 138° Centigrade; and here is a similar vessel, containing sulphur, maintained at a temperature of 143° Centigrade. Into each of these I will place a thin strip of caoutchouc. You see now that both strips are fairly vulcanised after having remained four minutes in the sulphur. Had these strips been allowed to remain for a much longer period in these hot sulphur baths, they would have become over-vulcanised, or converted into a horn-like substance. In these cases the two stages are traceable:—

1st Stage.—The incorporation of sulphur with the rubber by absorption.

2nd Stage.—The chemical union of the sulphur with the rubber.

Rubber which contains sulphur incorporated with it may be conveniently referred to as "mixed rub-

ber," in order to distinguish it from vulcanised rubber, or rubber which has chemically reacted or combined with sulphur. It is, at present, a matter of uncertainty whether the change which takes place on heating the "mixed rubber" consists in the direct combination of this element with the caoutchouc, or in the replacement of a portion of that hydrogen which exists in the caoutchouc by an equivalent quantity of sulphur; but this latter view of the case is confirmed by the fact that a trace of sulphuretted hydrogen is always evolved during the mutual reaction of sulphur and caoutchouc. It is, however, certain that the proportion of sulphur actually concerned in working the change called vulcanisation is extremely minute; although it is necessary, in most cases, for a considerable excess of sulphur to be present during vulcanisation.

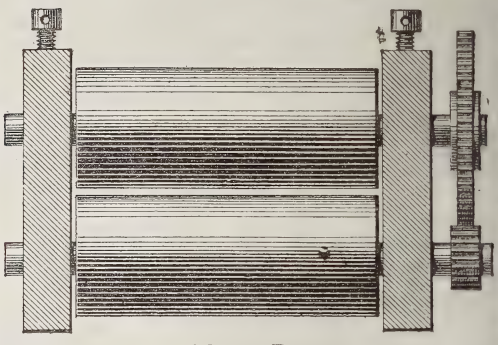
The process of vulcanisation by means of the sulphur bath is one which offers many inconveniences, when carried out on an industrial scale, although it is admirable as a laboratory process, or as a means of studying the operation of vulcanisation. If large articles are to be operated upon, it is by no means easy to ensure an equable action of the sulphur, as it is difficult to keep all parts of the bath at the same temperature; and, when some portions of an article are thin while others are thick, it is scarcely practicable to vulcanise the thick parts all through without overdoing the thinner portions of the article. Again, weights or frames must generally be provided, in order to keep the india-rubber fairly beneath the surface of the melted sulphur, and any trace of solvent remaining in the joints of the goods often becomes volatilised in the bath, causing "blow-holes" or other defects.

These circumstances have made it more general for manufacturers to incorporate the sulphur with caoutchouc by mechanical means, and then to fabricate the "mixed rubber" into the required forms; after which, vulcanisation is brought about by exposing the articles to the required temperature. This mode of procedure affords an opportunity for the admixture of mineral or other matters with the caoutchouc, such additions being often necessary, either to colour the material or to give it that hardness which is occasionally required; while it is often advisable to replace the sulphur, either partially or entirely, by certain metallic sulphides, such as vermilion or the orange sulphide of antimony; but these sulphides have scarcely any vulcanising action, unless they contain some free sulphur.

The apparatus employed for incorporating sulphur with the caoutchouc consists of a pair of rollers, which somewhat resemble the washing rollers, only they are plain on the face, and revolve at unequal speeds—three to one being a usual difference between their rates. The lantern slide which is now projected on the screen (Fig. 15) will give you some notion of these rollers.

The rollers having been heated inside, by means of steam, a charge of about 30 lbs. of the washed sheet rubber is worked through the machine until it has become tolerably softened and plastic; after which powdered sulphur is sprinkled on the rubber as it enters between the rolls; and this sprinkling on of sulphur and working is continued until all the material is thoroughly incorporated. In ordinary cases, 3 lbs. of sulphur to a 30-lb. batch is the proportion employed, and the soft, mixed rubber may be further manipulated at once, or it may be stored away for future use. In most cases, the next

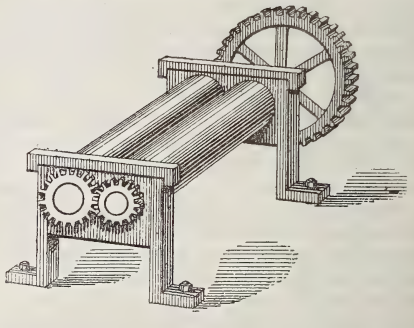
Fig. 15.



The Mixing Rollers.

step is to roll the material into sheets, as the major part of india-rubber articles are built up of these; and, for the purpose of fabricating these sheets, a large rolling machine, called a calender, is employed; but, before being rolled out by means of this machine, it is necessary to thoroughly warm and knead the mixed rubber, in order to make it plastic. For this latter purpose the warming rollers are made use of (Fig. 16), these being very similar to the mixing rollers, only they run at nearly an equal speed. The object of making a slight difference between the rates of the two rollers is to give the softened rubber a tendency to remain on one roller (that which revolves most slowly). It is scarcely necessary to say that the warming-up rollers are heated internally by means of steam.

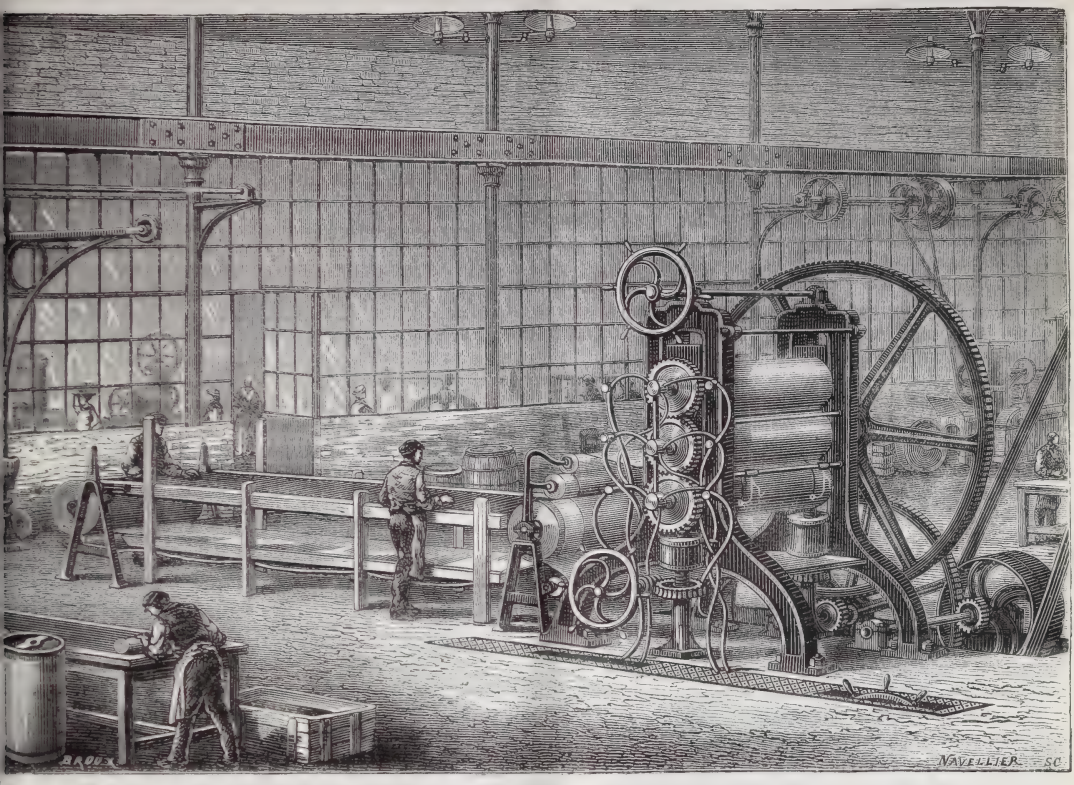
Fig 16.



The Warming-up Rollers.

The calender consists of three large rollers, capable of being heated internally by means of steam, and mounted in a massive cast-iron frame. The drawing now projected on the screen (Fig. 17, p. 775) will give you some idea of the nature of the apparatus, although some accessories are here represented which are not generally used in this country. The softened rubber is first passed between the top roller and the middle one; while the sheet thus formed adheres to the middle roller, and is brought between this and the bottom roller, where it becomes loosely attached to a cloth, which passes

FIG. 17.

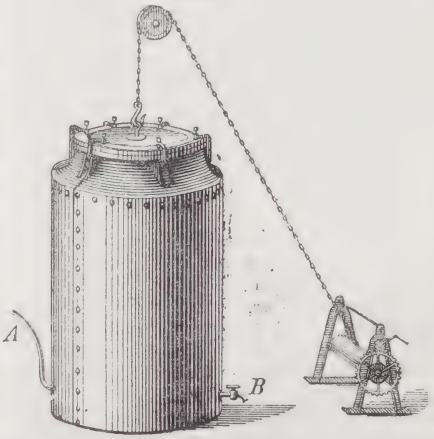


THE CALENDER, OR ROLLING MACHINE.

through with it. In some cases, a calendering machine with four rollers is employed, but it is questionable whether any proportionate advantage is gained. There are, on the table, some specimens of calendered sheets of various thicknesses; and I can very well illustrate the operation of rolling out the softened rubber by means of this small rolling machine. The soft sheets may be made to adhere together by merely bringing them in contact while warm, or by cementing them with a little of the mixed rubber dissolved in benzole; and it is a very easy matter to make even extremely complex articles out of the material in question, as the mastication and mixing have so far detracted from its elasticity and toughness that it may be worked almost like putty, provided that it is gently heated. This latter circumstance is more especially true of rubber, with which a considerable amount of any inert powder—such as clay, plaster, or oxide of zinc—has been incorporated. Although the rubber is so far degenerated by the masticating and mixing processes as to become plastic, and capable of being moulded with ease, it is merely necessary to expose it to a heat of 135° Centigrade for two or three hours in order not only to restore the lost elasticity, but to give it the enormously increased strength and elastic power due to vulcanisation. The operation of heating the mixed rubber, in order to induce its reaction with the mixed sulphur, is usually called "curing" the rubber. In most cases the heat of high-pressure steam, or of water under the influence of high-pressure steam, is employed for curing, as, in such cases, it is easy to ensure an equal temperature throughout; and, moreover, the rubber is protected from the action of the air. In some cases, however, it is more convenient to employ dry heat, as I shall explain to you in speaking of some of the special applications of india-rubber.

The steam vessels, or vulcanisers, in which the operation of curing is performed, are constructed

FIG. 18.



A VULCANISER.

somewhat after the fashion of boilers, but are provided with large removable lids, in order that the goods may be placed in position and removed. These vulcanisers are in communication with the steam-supply pipes of the works, and are provided with pressure-guages and thermometers, in order that those in charge may be enabled to regulate the in-flow of steam. Such a vulcaniser is now shown on the screen (Fig. 18, p. 775), but it does not require any special explanation beyond that already given.

The next lantern slide (Fig. 19, p. 778) which I have to show you represents the curing-shop or vulcan-house of a rubber works. You will notice the large vulcaniser near the middle of the apartment, and several small ones round about. The long, horizontally-placed vulcaniser—of which one end is shown towards the right hand side of the picture—represents the kind of vulcaniser ordinarily used for curing tubes, these tubes being laid in a long tray containing powdered French chalk.

On the table, and round about it, are several small vulcanisers, suited for experimental work. This one (Fig. 20, p. 779), known as Child's, and manufactured for the use of dentists, by Messrs. Ash and Co., of Broad-street, Golden-square, being a very convenient apparatus. It consists of an iron boiler, provided with a lid, which carries a safety valve and an arrangement by which a thermometer can be so placed as to indicate the internal temperature. A little water being placed in the boiler, the articles to be vulcanised are supported over it, and the heat necessary for the generation of steam is produced by means of the gas-burner. Messrs. Ash also construct still smaller vulcanisers, which are suited for use on the table of an ordinary room (Fig. 21 and 22, p. 779).

Here is a very ingeniously constructed apparatus, made by Mr. Walker, of Birmingham, in which the pressure-guage is so connected with the gas supply, that an undue increase of pressure reduces the amount of gas admitted to the burner; but it is scarcely necessary to say that an automatic arrangement of this kind does not altogether do away with the need of some kind of intelligent supervision during the use of the vulcaniser.

As before mentioned, it is a very usual practice to mix mineral and other matters with the rubber during the incorporation of the sulphur, and it sometimes happens that as much as 80 per cent. of foreign matter is mixed with the rubber in this way. The presence of a large proportion of inert matter naturally detracts from the elasticity of both the mixed and the cured rubber, the former working almost like soft dough in the calendering machine, and this at a comparatively low temperature; while the cured rubber is hard, and comparatively inelastic. The presence of a considerable proportion of inert matter generally diminishes the length of time required for curing.

The powders most extensively employed for thus lowering the quality of rubber are the following:—Clay, chalk or whiting, French chalk or talc, barium sulphate, plaster of Paris, oxide of zinc, sulphide of zinc, sulphate of lead, various oxides of lead, oxy-carbonate of lead or white lead, magnesia, silica, and fuller's earth.

Some of the above-mentioned materials, specially prepared for the rubber manufacture, are shown in the collection of india-rubber chemicals kindly lent to me by Messrs. Forster and Gregory, of Streatham; and these manufacturers also exhibit some qualities of sulphur specially purified for use in the vulcanisation of caoutchouc. It is a matter of considerable importance that the sulphur employed for mixing with caoutchouc should be free free from all trace of acid, and also from the moisture which acid samples of sulphur tend to absorb from the atmosphere. Ordinary flowers of sulphur—prepared by passing sulphur vapour into large chambers constructed of masonry, so that this vapour shall condense into minute crystals resembling snow—is almost invariably acid in its reaction, as traces of sulphuric acid are formed by the oxidation of the sulphur. This acid may be removed by washing the flowers of sulphur with an abundant supply of water, and then drying it at a gentle heat.

Here is a sample of ordinary commercial flowers of sulphur, and here is some of the same which has been washed and dried. I will put a little of each on a sheet of blue litmus paper, and then moisten them with alcohol. You see that where the unwashed sulphur was placed, the colour of the litmus paper is changed to red, owing to the action of the acid, while the colour of the litmus paper has not been in any way altered by the washed sulphur. All samples of sulphur ought to be tested in this way before being employed for mixing with india-rubber. Powdered roll sulphur is very often made use of, and it has not so much tendency to be acid as is the case with flowers of sulphur.

The so-called milk of sulphur—or precipitated sulphur—exists in a very fine state of division, and, as far as this circumstance is concerned, it is especially adapted for mixing with india-rubber; but, on the other hand, it is expensive, and is liable to be damp.

All excess of sulphur in vulcanised rubber beyond that actually required is undesirable; but, in order to ensure perfect vulcanisation, it is necessary to employ considerably more than that which actually combines with the rubber. This excess sometimes effloresces out on the surface, becomes acid, and leads to the destruction of the rubber. It appears also sometimes so to combine with the rubber as to make it brittle and useless. In the case of articles presenting no great degree of thickness, the greater part of this injurious excess of sulphur may be removed, either by boiling them in a dilute solution of caustic soda, or by means of a solution of sodium sulphite. Another method of producing vulcanised rubber, which shall be free from any great excess of sulphur, consists in replacing a considerable proportion of the sulphur originally mixed with the caoutchouc by a metallic sulphide.

The sulphide of antimony is that which is most extensively employed at the present time, the use of this having been claimed by Charles Hancock in a patent dated January 12, 1846; while, in a patent dated February 10, 1847, he fully recognises the fact that free sulphur ought to be employed in conjunction with the sulphide of antimony. Sulphide of antimony for the rubber manufacture is prepared by boiling the native sulphide in a solution of caustic soda, and precipitating the solution thus obtained with a slight excess of hydrochloric acid. Here is an alkaline solution of the native sulphide,

and you see that when I add hydrochloric acid to it, an abundant orange precipitate is produced. This, when washed and dried, is ready for mixing with the caoutchouc.

The sulphide of antimony thus prepared contains, under ordinary circumstances, a certain proportion of free sulphur; but, in order to obtain the best result with the sulphide of antimony, it should contain as much as 20 or 25 per cent. of sulphur in an uncombined state. This can be insured by adding the requisite proportion of sulphur to the caustic soda in which the original native sulphide is dissolved. The well-known red rubber is vulcanised by means of the sulphide of antimony, and the superior qualities of this kind of rubber over the ordinary grey article are generally recognised by the public. The absence of any considerable excess of free sulphur renders it less liable to decay under the influence of time and light, while it is less subject to destruction by fatty matters than rubber containing an enormous excess of free sulphur. The quality of commercial red rubber is, however, somewhat variable, and I have met with samples which were scarcely vulcanised at all, the sulphide of antimony employed being probably deficient as to the amount of free sulphur present. When the sulphide contains from 20 to 25 per cent. of sulphur, it is generally not necessary to mix more than 15 to 20 per cent. of the sulphide with the rubber; but when a sulphide of antimony containing less free sulphur is employed, it is possible to add a much larger proportion to the rubber with advantage. No manufacturer should ever employ a sample of precipitated sulphide of antimony without first ascertaining that it contains a proportion of free sulphur suited to his work. Extra sulphur may be added in the form of milk of sulphur, but this proceeding is not so satisfactory as taking the right thing to start with. Other sulphides, such as lead sulphide, mercuric sulphide, or zinc sulphide, are occasionally employed as vulcanising agents; but, in order that they may act in the most satisfactory manner, it is necessary for some free sulphur to be present; and the amount of this free sulphur should always be exactly known, in order that the vulcanising may be a matter of certainty, rather than the result of a kind of haphazard guess work. Sulphide of mercury or vermilion intended for use as a vulcanising agent ought, in most cases, to contain as much as one-third of its weight of free sulphur.

The action of these sulphides is peculiar. They have but little vulcanising action themselves, but they enable the free sulphur which may be present to exercise its full force; or, in other words, they take the place of that large excess of sulphur which remains ununited with the rubber in ordinary cases. Well, then, the use of these sulphides renders it possible to avoid the presence of a large excess of ununited sulphur in the finished goods.

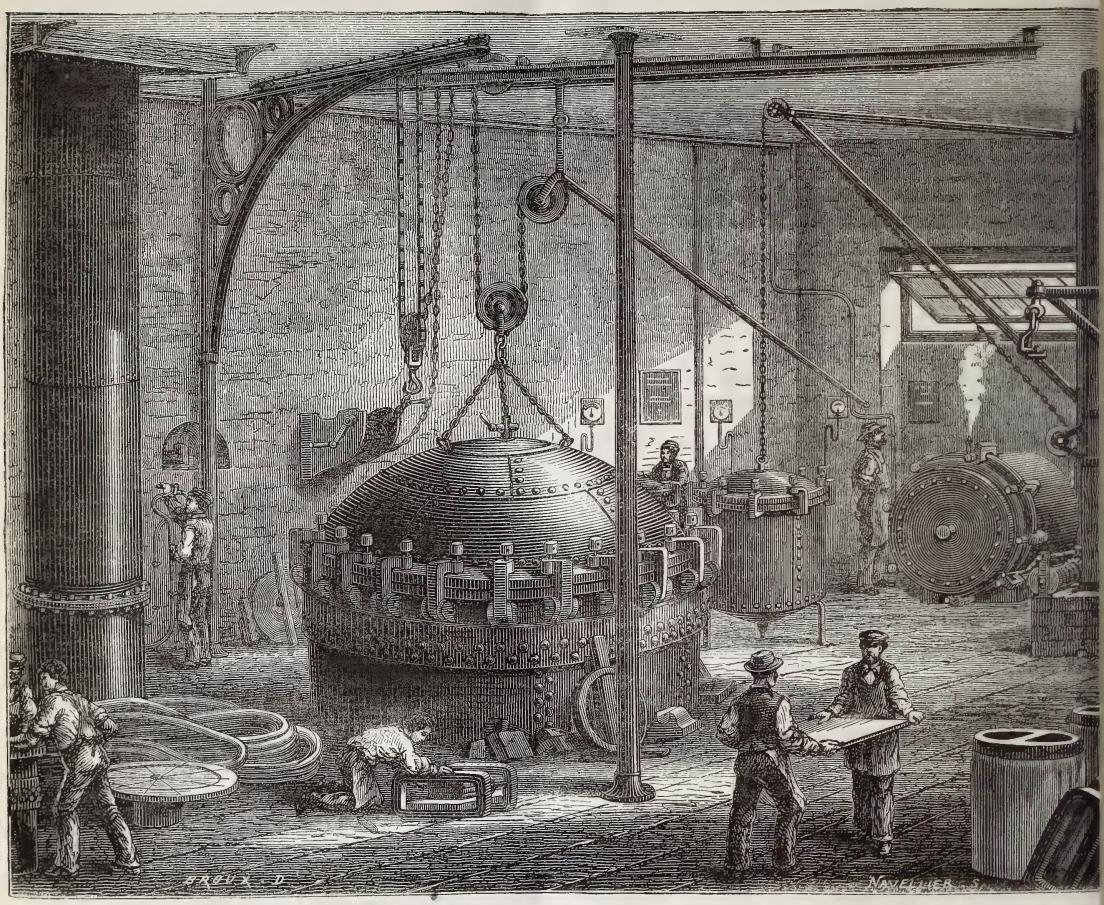
Some of the sulphides exercise by themselves a powerful vulcanising action; and among these may be mentioned the polysulphides of the alkalis and of the alkaline earths, as articles made of thin cut sheet may be very perfectly vulcanised by Gérard's process, which consists in exposing them to the action of a solution of the mixed polysulphides of calcium, at a temperature of about 140° centigrade.

Among Messrs. Forster and Gregory's specimens are many sulphides adapted for use as vuclanising agents, and others which are merely intended for use as colouring materials; these latter being, probably, free from any excess of sulphur. The fact of Messrs. Forster and Gregory being so well acquainted with the requirements of the rubber trade enables them to prepare sulphides suited for each particular kind of work. Among their specimens may be noticed the antimony vermilion, a very fine colouring matter, but not a vulcanising agent; the golden sulphide of antimony, which is specially prepared as a vulcaniser, and is manufactured in such a way as to ensure uniformity of composition, this being a matter of the greatest importance. Again, we have here yellow orpiment, a bright yellow colouring matter, which may be added to the rubber in any quantity, as it does not vulcanise to any appreciable extent; lead hydrosulphide, a curing agent employed in the making of single texture goods; zinc sulphide, a white colouring matter, which may be added to the extent of 40 per cent. to the rubber; zinc oxysulphide, a white colouring material, which is sometimes used in the last coating on spread textures, as it possesses the property of absorbing sulphur, and so prevents sulphuring up, or an efflorescence of sulphur from the more highly sulphuretted layers beneath.

When articles made of thin rubber—let us say cut sheet—are imbedded in powdered sulphur, and exposed to a temperature of about 112° Centigrade for some considerable time, as much as 10 per cent. of sulphur is absorbed by the caoutchouc, and this absorption is facilitated by rubbing the powdered sulphur on the surface of the caoutchouc. This method of sulphuring cut sheets, and articles made from cut sheet, is of considerable practical utility in many cases, and the goods so charged with sulphur may be cured in the ordinary steam vulcaniser.

Parkes' cold curing process, briefly referred to in a previous lecture, is one of the neatest things existing in the whole rubber trade. Here is a piece of cut sheet rubber, which I now dip for an instant in a mixture of one part of chloride of sulphur and 40 parts of carbon disulphide; after which, I lay it for a minute on a tray covered with French chalk and heated to about 40° Centigrade. The portion which was dipped is now vulcanised; perhaps not all the way through, but very nearly. This method receives numerous applications, especially for the vulcanisation of articles made from cut sheet rubber. In this case it is probable that the chlorine removes hydrogen from the rubber, and that the sulphur takes the place of the removed hydrogen. A study of the process in question shows us how very minute is the proportion of sulphur actually concerned in vulcanisation. In Parkes' process we have one of the most perfect vulcanising process existing, as combined sulphur alone reacts, and the finished articles are quite free from any trace of sulphur in an uncombined state. An after-treatment with water, or a weak alkaline solution, may be adopted to remove traces of hydrochloric acid. Light petroleum is now often employed in this process instead of carbon disulphide. Some hypo-sulphites, especially the lead salt, are

Fig. 19.



The Vulcan-house.

capable of acting as vulcanising agents but are not very extensively made use of. Vulcanisation by hypo-sulphites is, however, interesting, as affording another instance of combined sulphur acting as a curing agent.

Other re-agents besides sulphur exercise a hardening or vulcanising action on india-rubber; as, for example, nitric acid and the halogens. Warren claims the use of these latter bodies in his patent dated February 26, 1871, and he has very successfully vulcanised the insulating coating of telegraph wire by means of iodine. A piece of cut sheet rubber dipped into bromine becomes vulcanised instantly. Warren's process has been applied in America to the production of vulcanite bases for artificial teeth.

When sulphur and caoutchouc are mixed, there is a certain tendency for them to unite slowly, especially if exposed to the rays of the sun; a kind of gradual vulcanisation or curing being the result. This is very well exemplified in the case of the cork hat or helmets, manufactured by Messrs. Hawkes and Co., of Piccadilly, to whom I am indebted for this very complete set of specimens illustrative of their manufacture. The segments of cork, out of which these helmets are made, are cemented together by means of a solution of rubber in purified camphine, but a certain proportion of sulphur is added to the solution. During the time that the helmet is in use, the india-rubber cementing medium gradually becomes vulcanised, increasing in toughness and hardness by exposure to the heat of the sun. If, on the other hand, no sulphur were present, the rubber would rapidly deteriorate, and the helmet would fall to pieces if used in a tropical climate.

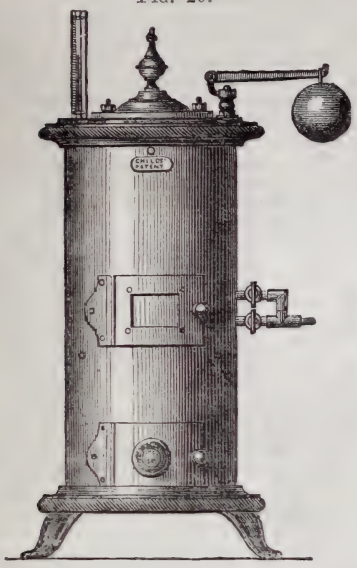
I have to thank several manufacturers for lending me many of the numerous specimens of vulcanised rubber which are before you this evening. Messrs. Macintosh, Hancock, Davis, and Henwood, the Silvertown Company, and others having been most kind in this matter.

The remarkable power which vulcanised caoutchouc possesses of recovering its shape after compression, is well illustrated by the fact that a sphere, $2\frac{1}{2}$ in. in diameter, passes between rollers set to a distance of a quarter of an inch without suffering any permanent injury as regards form.

Although vulcanised rubber is insoluble in the ordinary solvents of caoutchouc, boiling oil of turpentine will dissolve it; and sulphide of phenyl, a liquid discovered by Dr. Stenhouse, will soften

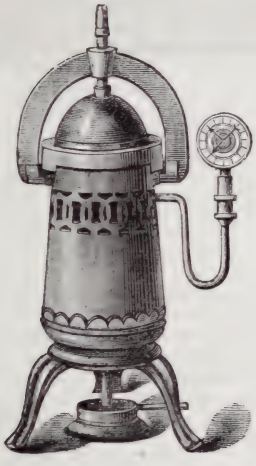
it so far as to render it re-workable. Old vulcanised rubber, reduced to a state of fine division, can be incorporated with new rubber in many cases, and

FIG. 20.



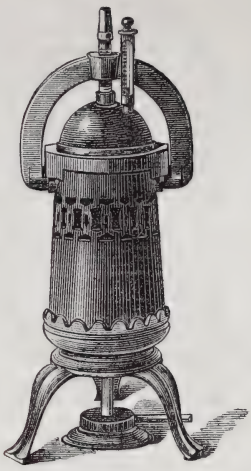
there are other methods by which waste vulcanised rubber may be utilised, as, for example, in the manufacture of kamptulicon, which will be referred to in the next lecture.

FIG. 21.



Oils and fats exercise a very destructive action on india-rubber, more especially when the caoutchouc is unvulcanised; and, through the kindness of Mr. T. S. Speck, engineer to the London District Railway Company, I am enabled to show you a very interesting specimen illustrative of this. It consists of a piece of one of the caoutchouc pipes employed to lead gas into the trains at the Hammersmith Station, and the pipe from which this specimen has been cut was placed in immediate proximity to the stopping-point of the engines. You see how deeply and thoroughly the pipe is corroded and destroyed by the action of oil from

FIG. 22.



the engines, while the other pipes in the station are in excellent preservation.

Some of the conditions which are favourable to oil-resisting powers, in the case of vulcanised caoutchouc, are as follows:—

1. The use of a high quality of rubber.
2. Thorough curing.
3. The absence of free sulphur in the finished article.
4. The presence of such pigments as litharge, red lead, or white lead.
5. The incorporation of a trace of glycerine with the materials.
6. Curing in a glycerine bath. (Placed in an ordinary steam vulcaniser.)

On the table you will see some interesting specimens, kindly lent by Mr. Tuck; these illustrate the matter in question, and you will notice how well Mr. Tuck's special oil-resisting rubber has withstood the action of mineral and other oils.

Ordinary vulcanised rubber gradually deteriorates when maintained at a temperature near 130° centigrade, becoming brittle and evolving sulphuretted hydrogen. This may be principally due to the reaction of the still uncombined sulphur on the caoutchouc. Exposure to the sun's rays will often produce a similar effect on caoutchouc containing free sulphur in considerable excess. Thus we see that, although both heat and exposure to light have a curing action on mixed rubber, the over-long continued action of either agency tends towards mischief.

MISCELLANEOUS.

BOTANIC GARDEN OF ADELAIDE, SOUTH AUSTRALIA.

The report of Dr. Schomburgk "On the Progress and Condition of the Botanic Garden and Government Plantations" at Adelaide, South Australia, for the

year 1879, contains a large amount of matter of interest both to planters and to commercial men generally. With regard to the introduction of new forage plants into our colonies, a subject that has occupied a good deal of attention of late, Dr. Schomburgk has given a full share of trial and experiment. Of the Chuffa, or Earth Almond (*Cyperus esculentus*) he says:—This tuberous *Cyperus* is extensively grown in the Southern States of America, for the sake of its fleshy tubers for sheep, hogs, and poultry feed. It is claimed to be one of the most profitable crops grown. The chuffa is an historical plant, which must have been cultivated extensively by the ancient Egyptians, as the tubers are frequently found in their tombs and other monumental buildings. These fleshy tubers contain a large per-centage of oil and sugar. The plant is still cultivated largely in Egypt, and is regularly taken for food. In Adelaide, Dr. Schomburgk says, the chuffa is planted in rows, two and half or three feet apart; two tubers should be dropped 20 inches or two feet apart in each row, and covered two inches deep, in this way about half a bushel is sufficient for one acre. In the Southern States of America they are planted during February and March. In Australia, the months of July and August seems best suited. The climate of South Australia seems to be quite suited to the cultivation of this plant, the seeds sown having, for the most part, germinated, and the plants being in a thriving condition. A singular plant, which Dr. Schomburgk classes among forage plants, is the Navdoo, which is described as a valuable and nutritious native forage plant, common in the interior of South Australia, where it supplies, in its small nut-like capsules, an article of food to the natives. It is found growing in the low undulating grounds on the Lachlan River and Liverpool Plains, and is relished much by the stock. It is proved from experiment to grow luxuriantly on dry and sandy soils, and to have withstood the severest droughts in the Adelaide-garden. "It is to be wondered," Dr. Schomburgk says, "that no person has yet attempted to introduce this valuable plant near the coast. No doubt the seed could be procured from the natives of the locality where it grows, and, if sown in autumn, the plants will spring up during winter, and provide a good pasturage. I would advise some of our enterprising squatters or farmers to try the plant. The trial should be made near the homestead, to have the opportunity of watching the growth of the young plants, and, if successful, the seed could be sown on the runs."

Regarding leguminous forage plants, the mesquite beans, the produce of *Prosopis pubescens and P. jubiflora* are strongly recommended for repeated trial and experiment. A correspondent, writing from Texas, says:—The great vitality of the mesquite tree is wonderful, flourishing everywhere in a great variety of soils and situations, subjected to the influence of tramping and superabundance of manure, as shade trees in stock pens, such as would soon kill many trees, it grows with renewed vigour. So far as I know, no one ever saw a mesquite tree killed by drought, though I have seen large numbers of forest trees, especially oaks, killed apparently by drought, when they stood in native positions, not only in the uplands, but in the plains. Though the mesquite bean has been introduced into other colonies, its success, so far as information at present goes, is not an ascertained fact. A plant of still more recent introduction to notice than the mesquite, is the Tagasaste, likewise a leguminious plant, but belonging to the section Papilionaceæ, and not to Mimoseæ, as does the *Prosopis*. The Tagasaste is a shrubby plant, native of the Canary Islands and Teneriffe, where the leafy branches are much used for feeding cattle. In its native country it is said to grow in a light dry soil, and is rather intolerant of frost in winter. The plants are cut, in the Canary Islands, two or three times a year, and will last from ten to twenty years. At Adelaide, the seeds which were sent from Kew have all germinated, and the plants, at the time of the report was written, had reached a height of from two to three feet, and were looking healthy, and not in the slightest degree affected by the severe drought that had visited the colony.

Of the grasses suitable for fodder purposes, the Egyptian or pearl millet is spoken of most highly, and is said even to be destined to take a place in the front rank of valuable forage plants. Grown in good soil, the plants at first appear feeble, resembling broom corn; but when a few inches above ground, they begin to put forth new shoots from the root, until they number from six to a dozen. The stems, at first, are nearly prostrate, but when about two feet long, they begin to assume an upright position, reaching a height of from eight to ten feet, and having the appearance, both in colour and substance, of Indian corn. When the stems have nearly reached their full height, the flower-spikes appear at the summit. As soon as the principal flower-spikes appear, the stems throw out lateral branches from every point, these in turn producing leaves and flower-spikes. When cultivated for fodder, the seed should be sown in drills, and plenty of room given, on account of the peculiar habit of tillering. The fodder is in the best condition for cutting and curing when the stalks are five or six feet high; the stumps, sprouting and throwing up a new growth, continue to grow until killed by the frost. All stock are exceedingly fond of this kind of millet, eating it with as much avidity, and apparent relish, as they do the green leaves of Indian corn. Regarding the now well-known Téosinté (*Euchlæna luxurians*), which has been introduced with varied success into many of the British Colonies, Dr. Schomburgk reports most favourably on its success in South Australia. The plant appears to withstand any amount of drought, the leaves retaining their healthy green, whilst the blades of the other grasses suffered materially. The plant possesses the habit of throwing out young shoots in a remarkable degree, numbering 60 to 80 on some plants, especially those growing in a moist situation. At the Government Garden, at Palmerston, in the northern territory, the growth of the plant has been surprising. In the course of five or six months they reached a height of from 12 to 14 feet, and one plant had 56 stems. After mowing, the plants grew again several feet in a few days. Cattle delight in it, both in its fresh and dry state. Dr. Schomburgk says:—"Undoubtedly, there is not a more prolific forage plant known, but as the plant is essentially tropical in its habits, this luxuriant growth is found in tropical and sub-tropical climates, although I can recommend the Reana (*Euchlæna*) as a most valuable summer forage plant, even in our dry climate, especially if they can be planted in a moist soil."

The question of flower farming in Australia, for the purpose of supplying the English markets with the materials for the manufacture of perfumes, has for some time been under consideration of those best qualified to speak on such matters. There is no doubt but that South Australia offers a suitable field for the cultivation of many well-known perfume plants. Dr. Piesse, writing on the subject, says that in a country that will produce oranges and lemons, there is no doubt that flower farms could be successfully established, and that all the plants most valued in perfumery, such as cassie, jasmin, mignonette, violets, &c., would also thrive. Dr. Schomburgk endorses this view, and says that most of the flowers which provide the material for perfumes grow most luxuriantly in South Australia, probably, indeed, to greater perfection than in any other part of the world. The same might also be said of medicinal plants, many of which might be successfully grown over large areas of land.

Dr. Schomburgk announces in this report the probable early completion of a new building for the Museum of Economic Botany on the same plan as the well-known establishment at Kew.

COLOUR-BLINDNESS.

Dr. Joy Jeffries has lately reported to the School Board of Boston, U.S., on the result of his examination of 27,927 school children for colour-blindness, with the following general results:—Of 14,469 male students 608 were colour-blind, or 4·202 per cent; of 13,458 female students 9 only were colour-blind, or 0·066 per cent." He adds, "these results are so near what is found by the best observers in Europe that we may take it as the expression of a general law. Colour-blindness is not curable by any known methods, and the colour-sense does not alter through life; hence the statistics gathered from the schools apply to the whole community. We may conclude that one male in 25 is more or less colour-blind, and that the defect very rarely occurs among females. I would here again respectfully call the attention of the Board to the fact that whilst something is done in the primary schools in reference to teaching the name of colours, the question of colour-blindness on the part of the boys is entirely overlooked. I have found, even in the higher schools, but few teachers who had any knowledge of colour-blindness, other than that it was an occasional curiosity. The uselessness of attempting to teach a colour-blind boy the names of colours, with the idea that he can afterwards apply them, is self-evident. I have taken great pains to describe this curious defect in all its defects to all the teachers of the classes I have tested, and explained to them the individual cases of colour-blindness as they occurred. In my previous report to your Board I spoke of the extraordinary lack of knowledge and use of colour-names by boys. My work in testing since then has still further convinced me that this does not show itself in school life, in examinations or exhibitions. Such want does, however, show itself very quickly when the boy comes out into every-day life and occupations. Thus it is that the necessity of teaching colours and colour-names to boys has been overlooked. It is naturally supposed that, in a general way, they must learn them, as girls do, from their occupations with coloured objects and materials. The fact is, however, as absolute experience has abundantly shown me and the teachers watching my work, that but very few boys of the grammar or higher schools are familiar with the colour-names of even the primary colours, and that still less can they correctly apply those names they do remember when shown coloured objects. Although prepared for this ignorance of the part of the boys to a certain extent, I confess I was astonished to find it so frequent and great. It seems almost impossible that a bright boy of fourteen, not colour-blind, should not know the word green, or be able to apply it. Yet this does not give an extreme idea of the truth in reference to the ignorance of colour-names and their application amongst our school-boys. Ignorance of colour-names, and their application, is not, therefore, confined to the young, since educated adults are equally at fault from the want of training the colour-sense during school life. I have received letters from adults, not colour-blind, whose lack of colour-names had been a serious drawback to them in their occupations in every-day life; and they have besought me to urge the teaching of colour-names, and the education of the colour-sense, in our public schools. The cultivation of the sense of colour is at present almost wholly neglected, as was once the sense of hearing and the voice. Colour-blindness, of course, has been as unrecognised as unknown. For this no blame can be attached to teachers, or those who direct their efforts. It is only since the colour-sense and its defects have been talked about and tested within the last three years, that here, as elsewhere in the world, it has been discovered that men were quite without the use and knowledge of colour-names compared with women, very much as it was wholly unknown, but equally true, that the latter were so extraordinarily exempt from colour-blindness. The systematic teaching in the lowest schools of colour-names and their application has already commenced in Europe, especially in Germany. This is due, in part at least, to the successful efforts of Dr. Hugo Magnus, of Breslau, in devising simple and effective methods of teaching, adapted to the capacity of teacher and scholar, and of such value as to receive a diploma of honour from the International Medical Congress which met last year at Amsterdam. The introduction into our primary schools of a similar system of instruction in colours and colour-names would save time now faithfully but aimlessly spent, and send the children into the upper schools ready to be further instructed, so that our school-boys would graduate ready to turn without chagrin or repulse to the every-day occupations of life which are with us calling more and more for an educated colour-sense, or rather a colour-sense with common school education. A few years of instruction have worked wonders in the ear, the voice, and the hand. Let the same be now done for our sense of colour, on which also so much depends. I would here repeat what I said in my report last year. It has been supposed, and even claimed, that the exemption on the part of females from colour-blindness was due to their familiarity with coloured objects and materials. This will not of course hold in reference to the individual, as the colour-sense cannot be changed by practice with colours. Whether generations of colour-education has caused this sexual difference is a point to be remembered, as, if sustained, it proves we may commence to eliminate colour-blindness from future generations of boys by teaching and practising their ancestors now under the charge of the School Board." Dr. Jeffries employed Prof. Holmgren's method of testing for colour blindness, as described in his work on the subject, which is noticed in the *Journal* (vol 28, p. 17).

BELGIAN EXPEDITION TO CENTRAL AFRICA.

Letters from Mr. Cadenhead dated Kwihara, Unyanyembe, April 17, and Munamurimuka, four days to Simba, May 18, are quoted in a late number of the *Times*. He intended to have pushed on from Zingeh in a straight line to Mukoundouko, as Stanley did, and thence to join the usual route to Unyanyembe; but the scarcity of food obliged him to turn south, and join the ordinary caravan route at Pembara Mpera, thence to Mizanzoh (where all his people had a frightful attack of purging and vomiting from inadvertently having drunk some bad water), to Mdabura, the westernmost part in Ugogo, and last station in that inhospitable country. From that point there is an uninhabited tract to pass called the Mgundah Mkali, and food is bought in Mdabura to last across. He was laid up with a severe attack of fever, and feared that in consequence he should miss his friend Mr. Carter, who he understood was to be at the coast in May, for the purpose of fetching up country some of the decoy elephants from India, and he supposed Mr. Carter had taken some cross route. It is reported that trained elephants cannot be had at present in India, so that both these travellers are now in Karema. The head man of Mr. Cadenhead's caravan—an Arab, Abdallah Ibn Rassan—kindly placed a large house at his disposal. The few Arab merchants live very comfortably in this place, and have imported from the coast various fruits, such as limes, mangoes, guavas, &c., and there is abundance of food; but there is something in the place that does not

agree with white men, for all seem to become sick here, from Livingstone onwards. Dr. Van den Heuvel, one of the Belgians who came up with Mr. Carter, is stationed here, and acts as victualling-agent for Karema, where the Belgian association has its station. The Arabs here were very kind to Mr. Cadenhead, and daily sent him presents of milk, fruit, bread, honey, and fresh butter, and all speak highly of Mr. Carter. A few days before arriving here he met an ivory caravan going down to the coast. There were at least 2,000 tusks, ranging in size from one carried with difficulty by two men, down to three or four to a bundle carried by a boy. He again speaks in glowing terms of the zebra flesh due to the rifle of his companion, Mr. Roger. On the 25th he writes he had another attack of fever—was better, and waiting to escort a caravan of provisions to Karema. Three of the donkeys sickened and died at Kwihara, which seems fatal to beasts as well as white men. From Munamurimuka, four days to Simba, on May 11, Mr. Cadenhead writes:—"To-day I met the post on the road, and send a few lines. Since writing from Kwihara I have had continued attacks of fever, rheumatic in form, and one since leaving that place. My strength has gone, especially in my legs, and a couple of hours' marching forces me to resort to my donkey." He had a letter from Mr. Carter, at Karema, who was hunting far and near in the vain effort to find a fowl with which to give him a welcome on his arrival at Karema, which is a place totally without food. There is nothing but Indian corn and what can be procured for the pot by the chase. At Kwihara, Mr. Roger and Mr. Burde, who came up from the coast, attached themselves to Mr. Cadenhead. Their caravan consisted of 100 and odd packages. Mr. Cadenhead was their guide and escort for three days, and, when left to themselves, they could not get their men to proceed, and unwisely disbanded them. They were then at a miserable little village, in an unsafe country, with valuable goods. They would be detained there for a month, at least. Mr. Cadenhead sent ten soldiers to remain by them until porters could be sent to bring their loads away. On May 18th he met Mr. Thomson, the Royal Geographical Society's traveller, on his way home. He described him as quite a youth, and looking very well after travelling upwards of 2,000 miles in unknown country. In Karema he hopes to stay only a very short time. It has been already described as a place without food or comforts of any kind. He heard that Mr. Carter had made a voyage on the Tanganyika from Karema to Ujiji, which, it will be remembered, is the place where Livingstone remained so long, and where he died.

Since the publication of these letters, news has arrived from Zanzibar of the murder of Mr. Cadenhead and Mr. Carter by an African chief.

GENERAL NOTES.

Brussels Congress on Commerce.—An International Congress of Commerce and Industry will be held at Brussels from the 6th to the 11th of September next, in connection with the 50th anniversary of the Independence of Belgium. The Sections are:—1. Political Economy. 2. Commercial Law. 3. Sciences. 4. Industrial Arts. The President of the Organising Committee is M. Antoine Dansaert, 135, Rue de la Loi, Brussels.

Migrations of Population.—Mr. Welton has shown, in a paper read before the Manchester Statistical Society (and alluded to in the *Journal*, p. 720), that the number of male inhabitants of the four counties, Wilts, Somerset, Devon, and Cornwall, enumerated in 1851 at the ages 5 to 20 was 266,246. The number enumerated 20 years later at the corresponding ages 25 to 40 was only 137,295. The loss was occasioned to the extent of 29,010 by deaths, the remaining loss, 99,941, being due to migrations. Setting aside Plymouth and one or two other growing places, it may be said that nearly half the male population at those ages had departed. The migrations are almost confined to the ages 15-30 years, as it likewise appears that 289,270 males, aged 30 years and upwards, in 1851 were reduced in the next 20 years to 139,835, the loss being due to mortality to the extent of 141,485 persons, and only a residual loss of 7,950 remaining to be accounted for by migrations.

Melbourne Social Science Congress.—The first meeting of this Congress will probably take place during the month of October, 1880, in connection with the Melbourne International Exhibition. Mr. Chester Earles, hon. sec. of the Music, Science, Fine Arts, and Literature Section of the Congress, is desirous of receiving papers on any of these subjects, which should be addressed to him at the Victorian Academy of Arts, Melbourne. Communications will be received as late as the 20th of October. Mr. Earles writes:—"It is the desire of the committee to render the meetings of the section in every way worthy of the occasion that has called the Congress into existence. They are anxious, accordingly, not only to turn to account, for purposes of instruction, the material resources of the Exhibition, but to enlist to the same end the active and zealous co-operation of exhibitors, of visitors, and of all others interested in the progress of music, science, fine arts, and literature. It must be understood that the Congress is not in a position to incur any pecuniary liability whatever in respect of any contribution; that the ordinary length of a paper should be such that its reading should not exceed twenty minutes; that the right of publishing any paper in such form and at such time as it may think fit, as well as the right of rejecting any paper, rests with the Council of the Congress; that no paper can be accepted which has been already made public; and that no accepted paper be published by its author until after the publication of the transactions of the Congress."

Exhibition of Wool, 1881.—The directors of the Crystal Palace propose to commence, in 1881, a series of special International Exhibitions of different classes of manufactures, with an international exhibition of wool and its varied applications and manufactures, besides those of a few allied products, and of the machinery and implements relating thereto. They state that the demand for wool has increased with marvellous rapidity, and this raw material is produced more or less largely in all countries, but it is to the Australian and African colonies that Europe is now mainly indebted for its supplies of superior merino wool. Of the 411,000,000 pounds of wool imported into this country in 1879, nearly 355,000,000 pounds came from the British Possessions. The woollen manufacture now ranks second in importance of the British textile industries, wool being much preferred to any other material for nearly all clothing purposes. Although London is the centre of supply of wool to the Continent, and buyers are attracted here in large numbers, yet an interchange of manufactured product takes place even between competing countries. The directors will furnish motive-power for working machinery free, but any driving-belts, connections, or attachments required must be made at the expense of the exhibitors. All applications from intending exhibitors must furnish full particulars of the space required, and the objects intended to be shown, and be sent in to the superintendent before the 1st January, 1881. The exhibition will be open from June to October, 1881. Medals and certificates of merit will be awarded by competent jurors to be appointed.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Sceretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,448. Vol. XXVIII.

FRIDAY, AUGUST 20, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

Lecture IV.—Delivered February 23, 1880.

Special Applications of Vulcanised India-rubber. Mechanical and Engineering Applications. Surgical Uses. India-rubber Stamps or Stereotypes. Vulcanised Caoutchouc in the Dwelling-house, the Garden, Children's Playroom, and the Printing-office.

Few materials have received such numerous applications in the industrial arts as vulcanised caoutchouc; and, in many instances, the applications of india-rubber are of considerable commercial importance. So various, indeed, are the uses to which this material is applied, that the mere reading of a list of its applications would occupy much more than the hour allotted for this lecture—as a rough estimate, I should say it would take just about two hours and three quarters—so I will not do it, but will rather call your attention to a few matters which either are of special interest or happen to present themselves to me to-night.

A pad of india-rubber has a remarkable effect in deadening vibration or recoil, and a slab or sheet about an inch thick is a useful thing to place underneath an anvil, in order to reduce the noise arising from hammering thereon. Again, you know that railway-carriage buffers work against blocks of caoutchouc, these having a remarkable effect in reducing the destructive action arising from the jarring and striking of the carriages against each other. In the case of rubber intended for such purposes, there is, generally, no disadvantage in somewhat hardening the material, by admixture with either one of the inert powders already referred to as being suitable for lowering the quality of vulcanised rubber.

Here, among the articles lent by the Silvertown Company, is an arrangement for lessening the recoil of an ordinary shoulder gun or rifle. It consists of a plate of ebonite, faced with soft rubber, and is intended to be attached to that part of the gun which is placed next to the shoulder.

The production of threads of caoutchouc by the process of squirting, is one of considerable interest, and it can be illustrated to you in a very simple manner. Here is a metal apparatus, very similar in size and appearance to a small pewter squirt, and I will fill it with caoutchouc which has been softened by means of a small proportion of benzole. The beak of the apparatus being placed in the focus of the lantern lens, you see that a magnified image is projected on the screen. The piston being now forced into the cylinder, the softened rubber is driven out in the form of a cord or thread, which really descends from the nozzle of the squirt; but owing to the inverting action of the lens, it appears to ascend on the screen. The threads thus formed must be exposed to the air, in order that all traces of benzole may evaporate, after which they may be cured in any of the usual ways.

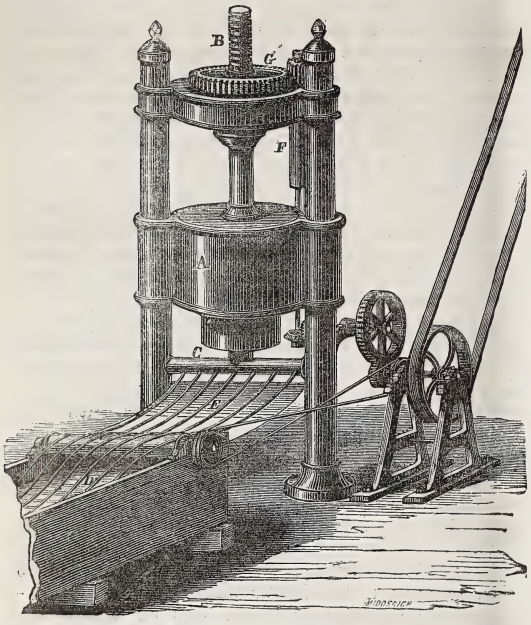
The drawing now projected on the screen (Fig. 23, p. 784) represents an arrangement for the production of threads by the process of squirting. A represents the main cylinder of the apparatus; while F is the rod attached to a piston, which fits into this cylinder. The piston is forced down by the gearing represented towards the right of the figure, and in the lower part of the cylinder a series of fine wire gauze strainers is fitted, in order to remove any solid impurities which may be present in the caoutchouc paste. The pressure of the piston next forces the india-rubber into a horizontal tube, marked C, the lower part of which is perforated by a series of holes, out of which the material exudes, forming a row of threads, these being then led forward by an endless band of velvet, E. The threads next pass into a trough, D, which contains running water; whence they are afterwards carried by a long endless band of calico or linen, on which they become sufficiently dry to be wound on bobbins, a little French chalk being made use of to prevent adhesion.

Washers and circular valves are largely employed for many purposes, and these may be cut out of the mixed rubber sheet, or they may be moulded out of the mixed rubber. In either case, they can be imbedded in French chalk during the process of curing by steam, or they may be cured in moulds, brass, tinned inside being a very general material for these. The merest trace of oil on the surface of the mould prevents any adhesion to it during the curing process. It may be premised that it is generally necessary to support articles of mixed rubber during the process of curing by heat, as the material softens very considerably before the true curing action steps in. Sheets are generally supported by being wound on a drum together with a cloth, and are then cured in water, while many small articles may be conveniently cured in moulds made of baked clay or slate, these being cheaper and more easily made than metal moulds. It often happens that it is more convenient to cut small washers and discs from the vulcanised sheets, although this course naturally involves some waste of material.

The firms which were mentioned at the last lecture have placed at my disposal the extensive series of specimens illustrating the above-mentioned uses of india-rubber, and you can examine these for yourself after the lecture.

The manufacture of the various kinds of tubing forms a very important part of the rubber industry. The usual manner of fabricating tubes is to cut the mixed rubber sheet in such a way that, when the edges are put together, no ridge shall be left pro-

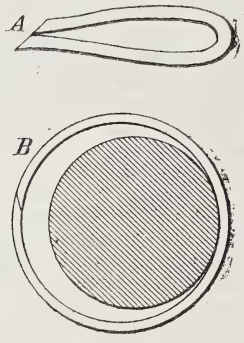
Fig. 23.



Apparatus for Making Threads by the Process of Squirting.

jecting on the inside or outside of the tube, a matter which is very well illustrated by the diagrams which will be immediately projected on the screen. (Figs. 24 and 25.)

Figs. 24 and 25.



A strip of the softened mixed rubber-sheet being bent over on itself, the edges are cut off as at A. On now placing the fresh edges together, as represented at B, they fit together, forming a tube, and a loosely-fitting mandril being introduced, the joint is strengthened by being rolled longitudinally with a small roller, resembling a minature garden-roller, made slightly hollow in the middle. The mandril is generally left in during the vulcanisation or curing of the tubes, the so-called "chalk cure" being adopted, as already explained. Very often the removal of the mandril presents some difficulty, and, in consequence of this, it is not unusual to employ a spiral wire instead of a solid metal mandril, this being left in the tube when sold. Machines have been constructed for the making of tubes, but with varying degrees of success. In the case of tube machines, a flexible core, or kind of rope, is generally used as a mandril. Tubes are often built up of alternate layers of india-rubber and canvas, this latter being saturated or filled in with softened rubber by means of the frictioning machine. The frictioning machine, one form of which is illustrated by the diagram now on the screen, somewhat resembles a calender; indeed, it often happens that the calender is fitted with gearing, to enable it to be used as a frictioning machine; and in passing between its rollers, the interstices of the canvas becomes so filled with the softened rubber, that the frictioned material can be worked in with the rubber when composite tubes are desired. In some cases a spiral wire is imbedded between two layers of india-rubber, the tube thus obtained being well adapted for suction purposes. The variety of tubes thus built up out of rubber, wire, and textile materials is very great, and the samples and sections lent by the Silvertown Company, Messrs. Davis and Henwood, Tuck, and others will be reviewed by you with interest.

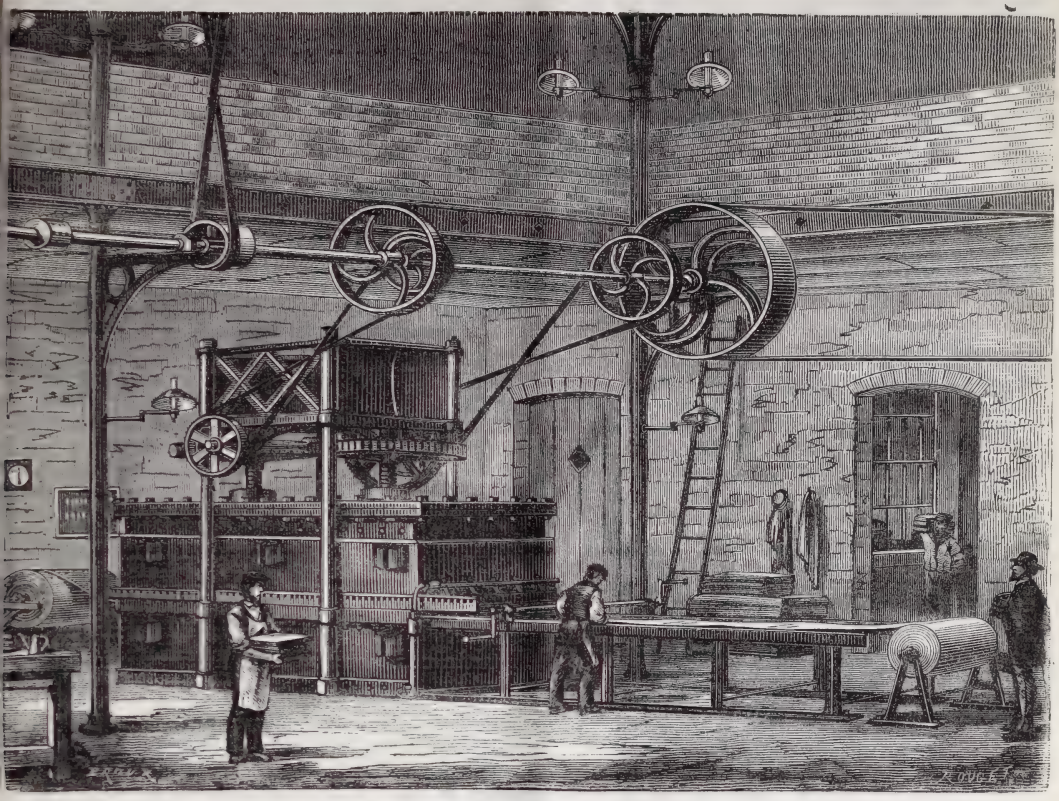
Another method of making tubes is by the squirting process already illustrated to you in the case of threads. In this instance, the mixed rubber, previously softened by heat, or by a solvent, is forced through a die, but this must be provided with a central core or mandril, to form the bore of the tube. Seamless tubes made in this way are very useful for laboratory and other purposes. On the table there are some interesting samples exhibited by Mr. Hancock.

The so-called insertion sheet, which is composed of alternate layers of rubber and frictioned canvas, is very useful, in case great strength should be required. Sometimes wire gauze is inserted between rubber sheets in a similar manner.

India-rubber steam packing is of very great value for making the stuffing boxes of engines steam-tight. It is also employed for packing the shaft holes of vessels, and other similar purposes. The steam packing generally takes the form of a cord, built up of india-rubber, frictioned canvas, and lubricated or stearined cotton. The extraordinary number of patterns or devices into which these materials are occasionally worked, is well illustrated by the sections which are exhibited by the Silvertown Company, and by Mr. Tuck. This gentleman has made an especial study of the manufacture of rubber packing, and you will be interested in studying his model which illustrates the method of placing the packing into the stuffing boxes, &c. Generally, packing contains a small square core of rubber, and this is bound round with several layers of frictioned canvas. In such a case, the india-rubber core gives the necessary spring or elasticity, while the frictioned canvas endures the hard wear; so tightness is secured in the stuffing box.

The use of gas bags, air pillows, beds, &c., formed of two thickness of cloth separated by a layer of rubber, has now become very general, and one can only appreciate the ingenuity exercised in the manufacture of such articles by either seeing them put together or cutting one of them open, so as to expose the method adopted in building it up. Gas bags have been found very useful for carrying

Fig. 26.



Steam Press for Vulcanisation by Dry Heat.

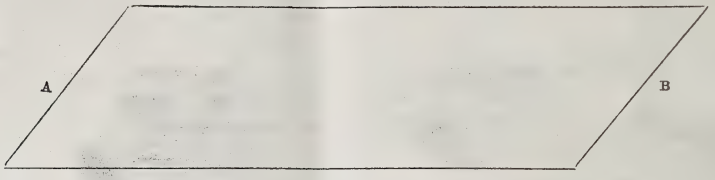
a supply of illuminating gas for the lighting of trains; but the use of them somewhat impoverishes the gas, as the caoutchouc absorbs several of those hydrocarbons which contribute largely towards its illuminating properties. As an insulating material for telegraph and other electrical wires, caoutchouc holds a very high place, and these specimens, kindly supplied by the Silvertown Company, and by Messrs. Rickards and Co., of Derby, will abundantly illustrate this use of india-rubber, and the method of coating the wires.

Belting, for the transmission of power, can be very advantageously made of alternate layers of rubber and frictioned canvas, these being built up to the required thickness. Belting is generally cured by dry heat, and in the following manner:—An iron mould, something like a gutter, is provided, this being planed out to the exact width of the belting. Into this gutter-like mould, which may be about 20 ft. long, a strip of iron fits accurately; so that a piece of belting introduced into the mould is enclosed everywhere excepting at the ends. One end of a length of made-up, but not cured, belting being introduced into the iron mould, the necessary heat for curing is applied by means of a massive steam press (Fig. 26), which consists of two rectangular cast-iron chests, heated internally by steam. Generally speaking, the chests are heated to a temperature as high as 150° Centigrade, in order that the vulcanisation may proceed quickly. In about 20 or 30 minutes, a fresh portion of the belting is exposed to heat in the mould, and so on until the whole length has been vulcanised. The method of vulcanising in question possesses the advantage of yielding belts with very accurately square edges, so that the whole width is available for the transmission of power. The steam press is excellently well adapted for the vulcanisation of figured or patterned sheets of caoutchouc, intended for ornamental purposes, and the engraving (Fig. 26) represents such a use being made of the apparatus. India-rubber belting should, naturally, be protected as far as possible from the action of oil, as the continual motion and straining very much favours the destructive action of fatty matters upon it.

Caoutchouc has been largely employed in the manufacture of surgical appliances, several examples of such uses of caoutchouc being now before you. Elastic stockings, belts, and bandages are of considerable value, as they exercise a more continuous and equal strain than would be the case with ordinary bandages. Messrs. Cow and Co. have provided some samples of their extra-elastic bandages, made out of spread sheet—a form of rubber which will be considered in the course of the evening. Other appliances—such as infants' feeding gear, injection apparatus, pessaries, &c.—are represented in the collection before you, but they require no special explanation.

As regards uses of caoutchouc bearing on every-day life, very much might be said, but the time is, unfortunately, rapidly advancing. The making of an umbrella ring is a very ingenious and curious operation, which I will proceed to illustrate to you. A strip of the softened and mixed sheet rubber is cut off obliquely at each end as you see me now cut it (Fig. 27), and after it has been rubbed over

Fig. 27.



with rubber solution to render it adhesive, the obliquely cut ends (A and B) are brought in contact, so that a short tube is formed. This being next placed on a mandril, one end of the short tube is turned over on itself continuously, so as to convert the tube into a round-rimmed ring. In practice the operation is conducted much more rapidly than I have done it. The rings are laid in French chalk and cured by a steam heat; but very often these articles, instead of being made of mixed rubber, are manufactured from cut sheet.

The squeegee is an instrument of American origin, and consists of a stoutish strip of vulcanised rubber mounted scraper fashion in a piece of wood. The scraper-like edge of the india-rubber slides with very great ease over any wet surface, forcing before it any dirt or foreign matter in a manner which is surprisingly complete. No doubt you have all seen the squeegee made use of for cleansing the roads and pavements in rainy weather. The squeegee forms an admirable window cleaner, as I can illustrate to you by applying one to a piece of dirty glass; but it must always be used in conjunction with an abundant supply of water, as the friction between india-rubber and dry glass is very great. Considerable use is made of the squeegee in several of the photo-mechanical printing processes, which I had the pleasure of illustrating to you two years ago, as some of you will doubtless remember.

Door mats of vulcanised rubber are now being extensively made use of. The mixture employed for their manufacture is generally of a very low quality; old vulcanised caoutchouc, fibrous materials, and mineral matters, such as whiting, being freely added; about 20 per cent. of a low quality of new rubber, such as African tongue, being often considered sufficient. The material having been calendered to the requisite thickness, a very partial and imperfect curing is generally effected at this stage, the sheets being exposed to a moderate heat between metal plates, these being often corrugated. After this the patterns of the mats are cut out by means of punches and cutters, the device having been stencilled on the sheet by means of French chalk dusted through a perforated metal plate. The mats are next laid in French chalk, and cured by steam. The punchings are worked over again, the slight preliminary curing or setting being insufficient to offer any notable hindrance to this course.

A very excellent method of manufacturing mats, but one not adopted to any great extent in this country, is to mould them in cast-iron moulds, and then to cure by the dry heat of the steam press (Fig. 26, p. 785). Other methods, such as building up the mats out of strips, are also occasionally adopted. Nearly related to door-mats are door-stops or buffers, articles of considerable utility in preventing damage to houses by a continual banging of the doors. Small blocks of rubber are often set in the door frames of railway carriages, to receive and deaden the first effects of the blow resulting from a rapid shutting of the doors.

In the manufacture of toys, the applications of caoutchouc are very numerous and often exceedingly ingenious. Here is a small air-ball, or balloon, to which is attached a wooden tube, provided with an india-rubber strip, acting as a reed. The reed does not vibrate while the balloon is being distended; and by closing the tube by means of one finger, the air may be retained in the balloon; but on removing the finger, out it goes with a rush, causing an unearthly screak, calculated to delight the infant mind. Hollow playing balls are made of four segments of calendered sheet, put together balloon fashion. Here is one at this stage; it certainly does not look much like a ball, but more like a withered pear, which has resided for some time in a square tube rather too small for it. The next step is to enclose the incipient ball in a hollow spherical mould, best made of slate, and to expose it to a vulcanising heat. The air inside the india-rubber now expands, forcing the material into close contact with the mould, and when the vulcanisation is complete, a perfect counterpart of the interior of the mould is the result. As the included air contracts, the ball, to some extent, collapses, as you see in the case of these samples; but by cutting a small circular hole in one of the balls, it, as you see, can be made to regain its spherical shape immediately. In some cases it is considered better to tightly distend the cured balls by compressed air; and this may be effected by attaching a small lump of unmixed rubber to the interior of the ball, before it is made up, and this lump undergoes no change in the curing process. When the cured ball is taken from the mould, a sharp-pointed or sting-like tube is passed through at the point where the lump is situated, and air is forced in through this tube. On withdrawing the tube, the hole closes, and the freshly-divided surface of the unvulcanised rubber unites again.

I do not think I told you anything about the

so-called india-rubber sponge, or froth-like rubber, which may be used for toilet purposes, as padding, or as rubbers for cleaning shoes or various other articles. It is made by incorporating with the rubber certain substances which will give off vapour or gas during the process of curing. Among these may be mentioned damp sawdust, crystallised alum, and carbonate of ammonia. The sponge is vulcanised in moulds, which it fills during the act of expanding. An ingenious application of the sponge rubber is made in the manufacture of a certain kind of playing ball. Some of the sponge rubber composition, which, by-the-by, may be compounded as follows :—

20 parts washed rubber of low quality.
10 parts red lead or other pigment.
50 parts old vulcanised rubber in a finely divided state.
8 parts sulphur.
6 parts damp sawdust finely ground.
6 parts oxidised linseed oil.

100

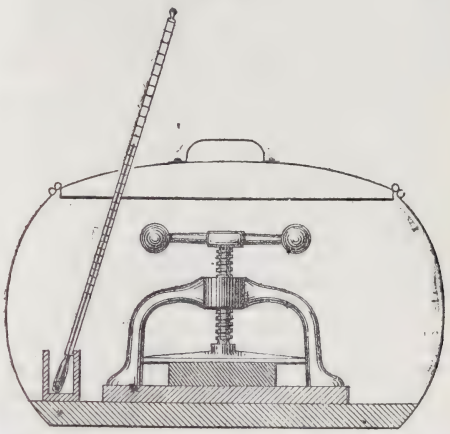
is wrapped round a small ball of wood, and the whole is then placed in a spherical mould somewhat larger than the wooden core and its rubber envelope. The heat necessary for curing being now applied, the rubber swells and fills the mould. On taking one of these sponge balls into the hand, its softness would naturally cause one to think it was made of a fine quality of rubber, and to wonder at it being sold at the low price charged; but, on cutting it in two, the mystery is explained ; a wooden core and a coating of very low quality sponge rubber being its factors. Very many hollow articles are made in moulds, in the same manner as the hollow balls; not only toys, such as dolls, being produced in this way, but also such goods as injection bottles and analogous articles; the principle of utilising the expansive force of air for forcing the rubber up to the sides of the mould being of widespread application in the rubber industry. Tin or cast-iron moulds are often employed, and, in some cases, a compression of air into the finished article is rendered unnecessary by adopting the expedient of forcing air into the article after it is placed in the mould, but before curing; the soft mixed rubber closing immediately on the minute hole, which is necessary for this purpose.

The use of india-rubber for cleaning paper and erasing pencil marks is a well-known application of the material, but its usefulness in this respect can be very much increased by incorporating certain gritty materials with it, such as pumice or finely divided silica. Messrs. Wolff and Sons exhibit a collection of rubber specially prepared for these uses; and they have adopted the plan of mounting the rubber, squeegee fashion, in wooden blocks. By this arrangement, contact between the hand and the rubber is avoided. Some people let their erasing rubber get very dirty, and then express surprise that it fails to clean paper.

Very pretty casts or mouldings of phototypic reliefs may be made in vulcanised india-rubber; and I will next illustrate to you the method of making such casts, at least as far as the manipulation of the caoutchouc is concerned. Here is an ordinary photographic negative, and this is a type metal cast or mould, produced by photographic agencies from the negative. Those portions of the negative which are opaque correspond to relief in the type metal mould, while the depressions of the mould correspond with the transparent portions of the negative,

The first step is to very slightly oil the mould, after which blacklead is applied to the surface, and the excess is polished off by means of a soft brush. A sheet of mixed rubber, previously softened by heat, is next applied to the prepared surface of the mould, and curing is effected by means of the small hot press into which the mould and rubber are now placed. A hot press of the kind now before you (Fig. 28) is very convenient for

Fig. 28.



Hot-press for the Vulcanisation of India-rubber Casts or Stereotypes.

the curing of small flat articles and casts. It consists of a cast-iron fish kettle, upon the bottom of which rests a slab of type metal an inch thick. Inside the kettle is placed a small press, like a copying press in miniature. By the side of the press stands a small iron cup, containing glycerine, and in this fluid is immersed the bulb of a thermometer, the stem of which projects through a hole in the cover of the kettle. By means of a small gas stove, heat can be applied to the apparatus, and it is easy to so adjust the gas supply, that the thermometer shall indicate a tolerably constant temperature of, say 140° or 150° Centigrade. Most qualities of mixed rubber will become fairly well cured by being heated under these circumstances for half to one hour, and any tendency towards adhesion to the mould is obviated by the preparation with oil and blacklead, as described.

This apparatus is extremely well adapted for curing the india-rubber stereotypes or stamps, which are now so extensively used for endorsement and other purposes. To make these stereotypes, a reverse or mould is made from the types, this being taken in plaster of paris, or better still, in metal. When plaster is employed it is well to harden it, by saturating it with an alcoholic solution of shellac, and again drying. The soft mixed rubber is then forced into the mould, as you now see me doing it, after which the curing may be effected in the hot press (Fig 28).

Mr. John Leighton introduced rubber stereotypes about 18 years ago, and since that time their use has become very general for a great variety of purposes. Mr. Leighton has very kindly sent, for your inspection, an interesting collection of specimens, illustrative of the manifold uses to which india-rubber stereotypes can be applied. Glass and other hard bodies may be printed on with the greatest ease; and by dusting the impression with a vitrifiable colour, the impressions may be burnt in. Here are some of Mr. Leighton's specimens, illustrating what was done in this direction, as far back as ten years ago. Again, the rubber stamps lend themselves admirably to the production of impressions on curved or cylindrical bodies; this being illustrated by rocket cases, printed under Mr. Leighton's directions, twelve years since. Much ingenuity is displayed in the construction of the various self-inking pocket and pencil stamps. These are before you, and you can examine them for yourselves.

I, for one, believe that the time will come when newspapers and books will be largely printed from india-rubber stereotypes. They can be easily and rapidly made, and I have cured rubber very successfully in the usual paper or "flong" moulds, faced with tin or lead foil, this latter being laid first on the type. The steam press (Fig. 26) might be employed for curing a rubber stereotype much larger than anything yet attempted in metal; and by employing a suitable rubber composition, it is not unlikely that a thorough curing might be effected in as short a time as ten or fifteen minutes. The power required to drive printing machines, working with rubber stereotypes, would be comparatively small, while impressions quite as sharp as those from metal ought to be secured. One advantage of the rubber stereotypes would be the ease with which they can be adapted to cylinders of any curvature. As regards ink for stereotypes, a few words may be said. A fatty ink naturally injures the rubber; at any rate, if it is not very carefully removed after use; but an ink having glycerine as a basis answers extremely well, and may, as the specimens on the table prove, be left in contact with the stamps without in any way injuring them.

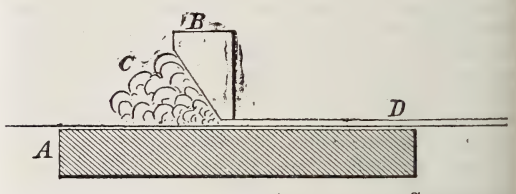
Inking rollers made of india-rubber have been occasionally made use of from time to time for many years, but owing to inexperience in their manufacture and use, the results have been, until quite recently, far from satisfactory. You will probably remember that, when lecturing here on photo-mechanical printing, I showed you how a printing roller could be made with a body of the usual soft gelatine composition, and a face of red vulcanised rubber, smoothed by means of glass-paper. This circumstance brought to my knowledge the fact that Mr. Robert Lanham had been very successfully labouring in the improvement of india-rubber rollers. By the kindness of Mr. Lanham, I was enabled to show you some of his rollers at the lecture immediately following the the occasion when I showed you my own. During the two years which have elapsed since that time, Mr. Lanham has still further developed the manufacture of rubber rollers for printing purposes, and I am indebted to him for the opportunity of now showing you the very fine collection of these articles which stand over yonder. Mr. Lanham makes his rollers from red rubber, which is, of necessity, very thoroughly cured, in order to enable it to withstand the action of fatty inks; and after the rollers have been turned true by means of self-acting lathes, a fine surface is given to the rubber by means of glass-paper. In order to give his rollers the softness which is necessary in some cases, Mr. Lanham now introduces a series of perforations parallel to the axis. For lithographic printing, these rollers have very considerable advantages over the usual leather roller, and some excellent samples of work done with them hang on the walls.

India-rubber does many services in connection with the art of printing, some of these being of very great interest, but it is impossible to go farther into the matter this evening.

Waterproof goods, consisting of a thin layer of rubber spread on a textile fabric, are very extensively made use of for the fabrication of overcoats, and other waterproof garments. In the manufacture of these goods, the first step is to prepare a dough or paste suitable for spreading on the material. If the vulcanisation of the coating is to be effected by means of steam heat, as in the case of cotton or linen goods, a composition of the following nature may be spread on the fabric:—20 lbs. washed rubber, 20 lbs. zinc white, 5 lbs. sulphur, 6 or 8 lbs. of solvent naphtha. When, on the other hand, the curing is to be performed by the cold process, the sulphur may be omitted. After the rubber has been softened by the absorbtion of the solvent naphtha, the materials are thoroughly incorporated by means of a mixing or kneading machine.

A very good illustration of the action of a spreading machine is afforded by the model which is now before you. It (Fig. 29) consists of a baseboard (A), over which is supported a rule-like bar (B).

Fig. 29.



Model Illustrative of the Action of the Spreading Machine.

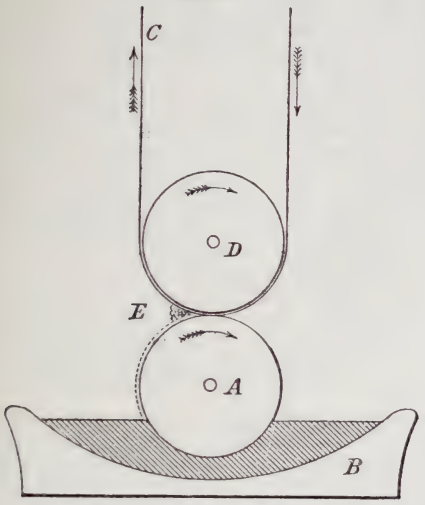
The material to be coated is placed under the bar, a quantity of the paste or dough is piled up in front of the bar (at C), and the cloth is drawn forward (towards D), so that the rule or bar cuts off an even layer of the soft mixture. In actual practice, the fabric, after having received a coating of the composition, is passed over a heated steam chest in order to dry off the solvent naphtha. In the case of ordinary goods, about six coats are given—three in each direction. Each coat may be estimated as being about one hundredth of an inch in thickness.

The method of applying the mixture of carbon disulphide and chloride of sulphur used for effecting the cold vulcanisation of the india-rubber coating, when spread on goods which would be injured by high-pressure steam, is of some interest. The coated fabric (C, Fig. 30, p. 789) passes round a roller

(D), coated side being outwards, and at the point, E, it is brought into contact with a more rapidly revolving slate roller, A, which dips in the vulcanising solution, this being contained in a trough, B. The solution, which consists of 1 part of chloride of sulphur, and 40 parts of carbon disulphide, is led upwards by the roller A, towards the point E, where it forms a kind of accumulation or wave. All excess drains back as the fabric travels towards the point C.

Double-texture fabrics can be produced by em-

Fig. 30.



Cold Curing of Spread Goods.

ploying similar apparatus, but double; and the two textures, which are vulcanised simultaneously, are brought into contact immediately after the curing solution has acted on them. Under these circumstances they adhere, but when made up into coats, &c., these double textures can be separated at the edges by the application of benzole; this being a matter of great convenience in joining the various parts of a garment together.

Spread goods are often varnished by the application of a dilute ammoniacal solution of shellac, the surface of the goods being generally prepared for the reception of this by the application of water, or of water containing a trace of an alkali, soap, or ox gall, either of which facilitates the adhesion of the lac varnish.

A large number of specimens of spread goods are on the table, these having been supplied by Messrs. William Currie and Co., of Edinburgh, the Silvertown Company, Messrs. Cow and Co., Messrs. Anderson, Abbott, and Anderson, and others.

Spread sheets, already referred to several times, are made by spreading a mixture of sulphur (or other vulcanising material) and softened rubber on clothes previously charged with a mixture of paste, treacle, and glue. The required thickness having been built up, vulcanisation is effected by means of steam, and the prepared cloth, being softened by the action of water, can be easily removed from the sheet of rubber. Sometimes the required thickness of spread sheets is built up on two separate pieces of the prepared cloth, and the adhesive surfaces of the rubber being placed in contact, they unite, after which vulcanisation is effected in the usual way, and the cloths are removed.

Spread sheets, prepared by the latter method, show the marking of the cloth on both sides, while those prepared by the first method are smooth on one side. As a general rule, spread sheets are more perfectly elastic than calendered sheets, as the rubber undergoes less mechanical tearing or deterioration. They are generally preferred for cutting into threads.

Mr. Sexton, the representative of the National India-rubber Company, of France, has kindly lent me a well-assorted set of specimens, illustrating the use of caoutchouc in the manufacture of boots and overshoes; this firm turning out over two millions of pairs yearly. Articles of this kind are generally made out of a mixed rubber, which is calendered on to woven or knitted fabrics, these having been previously frictioned. After the articles have been made up and varnished, they are cured in stoves or ovens, heated from 130° to 150° Centigrade.

Several processes have been proposed for the desulphurisation of old vulcanised caoutchouc, but the success attending endeavours of this kind has been very limited. The incorporation of old rubber with new has been referred to already. The use of old rubber in making the admirable floor-cloth known as kamptulicon, is a very useful application of it.

Kamptulicon consists of old rubber and cork, both materials being brought into a state of fine division, after which they are incorporated by heated rollers, and then rolled out into sheets. You need not seek far for a specimen of this material, as the floor of this room is covered with it. The Britania Rubber and Kamptulicon Company have lent me the figured and patterned specimens which are attached to the wall, and also other articles, which illustrate the various uses of this material. Knife-cleaning boards are often covered with it; and when made up into sheets, two inches thick, it is extensively employed as a means of deadening the effects of concussion. These thick sheets are particularly adapted for covering the floors of riding schools, or for lining cells in which violent lunatics are confined.

MISCELLANEOUS.

LONDON WATER SUPPLY.

The report of "the Select Committee appointed to inquire and report as to the expediency of acquiring, on behalf of the inhabitants of London, the undertakings of the existing metropolitan water companies; and also to examine and report whether certain agreements, or any of them, already entered into provisionally for the purchase of these companies would furnish a satisfactory basis for such an acquisition; and further to inquire and report as to the nature and extent of the powers of the water companies to levy water rates and rents, and how far it may be desirable to modify the same," dated August 3rd, has just been issued, and is as follows:—

(1.) That it is expedient that the supply of water to the metropolis should be placed under the control of

some public body, which shall represent the interests and command the confidence of the water consumers.

(2.) That under such management a greater efficiency, economy, and equality of charge than that which at present exists might be secured; the defects in the present provision for the extinction of fire might be remedied; and better provision might be made for the health of the community.

(3.) That in order to effect the above-mentioned objects, a water authority for the metropolis should be created with statutory powers, which will enable such body to acquire and utilise, so far as may be deemed expedient, existing sources of supply, and to have recourse to such other sources of supply as, upon investigation, may prove to be available and desirable.

(4.) That in the absence of any single municipal body to which these functions could be committed, a water authority of a representative character should be constituted, and that a Bill having that object be introduced at an early date by her Majesty's Government. Without absolutely prescribing the composition of such a body, your committee are of opinion that it should include elements to be derived from the Corporation of London and the Metropolitan Board of Works, together with a due representation of the districts at present supplied by the metropolitan water companies, which lie beyond the jurisdiction of the Corporation and the Metropolitan Board. It is on such body, when properly framed, that, in the opinion of your committee, should devolve the responsibility of determining questions affecting the source, the nature, and the price of the water supply of the metropolis. The subject is one which especially concerns the consumers of water, and should be left to the judgment of a representative body, furnished with adequate power to give effect to such measures as, on mature consideration, may be determined.

(5.) That for certain purposes, at least, it would be desirable to acquire the undertakings of the existing companies, if the same could be obtained upon fair and reasonable terms.

(6.) Your committee have investigated the terms negotiated for such a purchase in the agreements referred to them, which were provisionally concluded between the metropolitan water companies and Mr. E. J. Smith. These agreements are printed in the appendix to this report, and their financial results are set forth in a Parliamentary paper, also printed in the Appendix.

The amount of immediate annuities to be paid under the agreements is £773,454; to this would have to be added deferred annuities, to accrue by way of increments at various intervals, amounting finally to £325,449, making an ultimate annual payment of £1,098,953.

The value of the immediate annuities in 3½ per cent. stock, taken at par, would be £22,098,700, and Mr. Smith estimated the present value of the deferred annuities at £6,851,300, making the total value of stock under the agreements £28,950,000. If the deferred annuities had been capitalised at 3½ per cent., the total amount would stand at £29,734,281.

In addition to this, it would have been necessary to make provision for the debt charges, viz., preference and debenture capital, amounting to £3,061,500, bearing an actual annual charge for interest of £133,913, and also for the bond and mortgage debt, £223,055, with an annual charge for interest of £7,807. These interest charges Mr. E. J. Smith calculated would, as well as the annuities, be covered by the income of the companies, when transferred under the agreements. adding these charges to the total of the annuities granted as above, the annual payments would have been finally £1,240,673, and the total capital value would have stood at £33,018,836.

These agreements were founded on the principle of paying so much in the way of immediate annuities, in consideration of the existing net income of the companies, and so much by way of deferred annuities, in regard of the anticipated increase from year to year of their revenue.

The present net income of the companies is a figure which is capable of being accurately ascertained and adjusted. It is admitted that the immediate annuities to be granted under the agreements were in excess of the actual net income realised in any year of which we have completed accounts. Mr. E. J. Smith, however, alleged that the annuities he proposed to grant would be met by his estimate of net income for the year ending 1st June, 1881. But the question of the future increments is a matter, to a great degree, of estimate and speculation. Their amount must depend on numerous elements, at which it is only possible to conjecture, such as the future rate of the growth of houses, and, the probable increase in their value; the future rate at which the water rentals are to be fixed; and the future capital which it may be necessary to expend. These are the elements from which the growth of the past has been compounded; whether they will increase or decrease, or remain stationary hereafter, is altogether uncertain. It seems that the calculation of increments, on which the agreements proceeded, was founded on the assumption that all the items of receipt would grow at a greater rate in the future than in the past; that the number and the value of the houses and the rate of the rentals would perpetually augment; but that, on the other hand, the growth of capital expenditure, which has hitherto been required in order to earn an increased income, would sink almost to nothing, and might be discarded from the calculation. This does not appear to be a sound basis of a financial estimate for the future.

In the investigation before your committee, the Corporation of London and the Metropolitan Board of Works have taken part. Those two bodies, on behalf of the water consumers, whom they may be taken to represent, have declared to your committee their opinion that the terms contained in these agreements do not furnish a satisfactory or admissible basis of purchase; and in that opinion your committee concur.

(7.) In the resolution communicated to your committee by the Corporation of London, it was stated that the price agreed to be paid, under the agreements, to the water companies, was nearly nine millions in excess of the market value of the property, at a period immediately previous to the commencement of the negotiation. As a general rule, the market value of stocks of this description affords the best estimate, not only of the present, but of the prospective value of the commodity. The expectation of future improvement is an element which always enters into the consideration of the market value. It was, indeed, suggested that, in the case of the water companies, their affairs were not sufficiently well known to the public, to enable a complete judgment of their value to be formed, and that their future expectations were not sufficiently estimated. But during the past six months, every possible light has been cast upon their affairs, and yet their market value is, at the present time, with a complete knowledge of their condition, still some millions below the price which was payable under these agreements. The value of the shares rose immensely on the disclosure of the terms of the agreements; they fell as soon as it was considered doubtful whether the agreements would be sanctioned; but at no time did they ever rise to the full value, which would have been due to them if the agreements had been carried into effect. It is obvious, therefore, that the judgment of the public, as evidenced by the market price, coincides with the opinion of the Corporation of London, and the Metropolitan Board, viz., that the price offered in the agreements is greatly beyond the estimated value of the property.

(8.) Your committee are further directed to "inquire into the nature and extent of the powers of the water

companies to levy water rates and rents, and how far it may be desirable to modify the same." It is admitted that rates have been raised in recent times, under the statutory powers of the companies; and the evidence shows that a considerable portion at least of the increase in the receipts of the companies has been due to this cause, as the increase per cent. in the net water rentals for the last eight years, has been in the case of most of the companies greatly in excess of the percentage of increase in the number of houses.

(9.) The companies claim the right still further to increase their rates in proportion to the growth in the value of houses, and this right would have no legal relation to the augmentation in the quantity or improvement in quality of the water supplied. If the companies were limited in the amount of dividend they could earn, as was contemplated by the Water Works Act, 1847, there might be some reasonable restraint on their power to enhance the charges against the consumer. But the companies assert their right, under the title of back dividends, to escape from any such limit. Indeed, their right to do so is made one of the grounds for demanding so large a price from the public for the purchase of their undertakings. The calculations on which the agreements were founded proceeded, to a considerable extent, on the assumption that the claim of the companies to back dividends was established. In the evidence of Mr. Smith, the possible amount of such dividends is estimated at nearly 20 millions. The counsel for the companies contended before the committee that the right to such dividends might be carried back to the origin of the company, which accounts for the astounding figures in the case of the New River Company, of £15,000,000, as the amount of back dividend. The counsel for the Corporation and the Metropolitan Board of Works maintained, on the other hand, that no question of back dividend could arise till the Act, which introduced a limit, came into force. Without pronouncing an opinion on the legal point, your committee must observe that, if the contention of the companies is well founded, the population of the metropolis and its suburbs, amounting to four millions of people, would be left at the mercy of certain trading companies, armed with the power of raising the price of one of the first necessities of life, to an extent, practically, without any limit; a situation from which the companies seem to consider there is no escape, except in the purchase of their undertakings, at such a price as they may be willing to accept. If that were the only remedy, the consequences to the consumer of the improvident legislation of the past would be indeed intolerable. But Parliament is not unequal to redress such mischiefs to the public interests. The manner in which the gas companies have been dealt with by Parliament, may be referred to, in illustration of the methods by which a remedy for such a state of things may be effectually provided.

(10.) Your committee have not had before them any specific scheme for an independent supply of water, and general speculations on the subject are of little value, without detailed plans of the sources from which it is to be derived, and the cost of carrying it into effect. But your committee would observe that the total cost of the existing water supply to the metropolis has not much exceeded 12 millions, a considerable portion of which sum may be attributed to works which have become useless, or have been re-duplicated. And it would become the duty of the water authority, when constituted carefully, to consider, with the professional assistance which will be at their disposal, whether a new and better supply could not be obtained, at a cost greatly less than the sum which would have had to be paid, under the agreements, for the existing supply.

(11.) In the constitution of the water authority, your committee would recommend that that body should be intrusted with the largest discretion as to the best method of dealing with the water supply of the metropolis. Various courses might be adopted. It would be possible to proceed by regulation of the powers of the existing companies, as in the case of the gas supply; or by the introduction of an independent water supply; or by the purchase of the existing undertakings. It would be the duty of the water authority maturely to examine which of these schemes, separately or in combination, would be most advantageous to the public. In order to give effect to any of them, further statutory authority would be necessary, so that the judgment of Parliament on any scheme adopted by the water authority would be finally reserved.

CORRESPONDENCE.

CHINA AND THE CHINESE.

The paper of M. Terrien de la Couperie (p. 725) is of much interest, and it is greatly to be regretted it was not read, so that it could have been discussed. As that was not so, it is desirable to make some remarks.

This paper confirms our knowledge of the connection of the Chinese with the older characters, and of some other relations of the people and language, and supports the researches of English scholars. It is gratifying to see M. Terrien's expression (p. 726) towards the Rev. J. Edkins, D.D., to whose labours he is indebted for the foundation on which he has worked. At the same time, M. Terrien carries out in detail the discoveries of his predecessors, and his determination of the character of the Yh King works out the ancient doctrine that the physical theories of this ancient book influenced the maker of the characters, and contributed to their use in divination. When we obtain from M. Terrien particulars, we shall doubtless be in a position to ascertain to what extent he has been able to push his inquiries.

In his introduction to the "Study of the Chinese Characters" (London: Trubner and Co., 1876), Dr. Edkins has laid down the philological history of the characters, and their relations to Mongol. This task he had begun in "China's Place in Philology." The system of Dr. Edkins was subjected to very severe criticism, particularly by that distinguished Chinese scholar, M. Stainslas Julien, and by the equal authority in Japanese, if not Chinese, M. Leon de Rosny. Dr. Edkins wisely persevered, notwithstanding doubts in the collection of facts, and it is difficult now to deny the resemblance of Chinese to the Ugro-Altaic languages.

M. Terrien very well describes at pp. 727 and 729 the system of Dr. Edkins, which he has pursued, and enumerates eleven categories, from which the ancient forms and sounds of the Chinese words are restored, such as the Chinese dictionaries, the modern Chinese dialects, the old rhymes, and that important feature, the employment of characters in the classics, &c., with a signification different from their ideographic value. Dr. Edkins particularly regarded the Mongol and Japanese forms.

Dr. Edkins went through the enormous labour of examining the 214 radical characters and the 1,040 (or more) Phonetics. Thus he has supplied invaluable material for all inquirers, and to him we are all greatly indebted.

The relations of Chinese with other languages are so obvious, that the facts have been stated by many (Dr. Latham, Dr. W. W. Hunter, New Aryan Dictionary, p. 23, Dr. Edkins, Hon. Randolph Clay, Mr. Bancroft, amongst many others). These relations have, however, been denied by many eminent men, on the ground that such likeness is to be regarded as a matter of chance.

The relation between Akkad and Ugro-Altaic (Ural-Altaic), and between Akkad and Ugro-Altaic being known, it was easy for us to connect Chinese and Akkad.

M. Terrien, in accepting these affinities, at p. 729 says that he was led (that is, by the facts pointed out by Dr. Edkins) to recognise in the Chinese spoken language an ancient member of the great family of the agglutinant languages, known as Ural-Altaic. At p. 730, however, he says that he closely connects ancient Chinese with the Akkadian and Susian dialects, and not with the Ugro-Finnish tongues. What this means does not clearly appear, but the conclusion is erroneous. I long since pointed out that Akkad is not Ugro-Altaic, and the words cited by M. Terrien do not prove that Chinese is to be classified with either.

The connection of Chinese characters with the cuneiform and the Egyptian has been long since under the eyes of the scientific world. For my own part, I read a paper "On the Prehistoric Relations of the Babylonian, Egyptian, and Chinese Characters and Culture," before Section D at the British Association, at Dublin, in 1878. This was noticed in most of the papers at the time, and an abstract will be found in the *Journal of British Association*, p. 590.

M. Terrien gives some examples of characters of common origin in Chinese and cuneiform. He says he has not noticed some others, as "mouth," "sun," "star," "moon," &c. (p. 731), because he is under the impression that "they could only be represented in the same manner, and are without value." This statement must be made, because he neglects the true connection of the emblems, their relation to sounds, and their psychological bearings. Some very good proofs in support of the general argument are, indeed, to be obtained from some of the rejected materials.

M. Terrien has given some interesting examples of the affinities between Chinese and Babylonian institutions, and which are well worthy of attention, and with which I propose to deal hereafter.

The real bearing of the facts is not on any connection between the Babylonians and the Chinese, but to the relation of these facts to the general subject, and to the question of the derivation of the institutions in each case fom one common source, as is evidenced by the characters.

Indeed, M. Terrien (p. 735) has an idea that this may be so as to the characters, and that there is a question of the re-discovery of an older system of writing than the Akkad, and that he could not then examine how far this would be possible. It is, however, possible, for the evidence is abundant, but it does not bring out his form of result.

Hyde Clarke.

32, St. George's-square, S.W.,
August 7th, 1880.

GENERAL NOTES.

Iron and Steel Institute.—The Autumn meeting of the Institute will be held at Dusseldorf, on August 25th, 26th, 27th, and 28th, 1880. Among the special excursions arranged for the members are visits to the following works:—To the Rhenish Steel Works (where the basic process of dephosphorising iron is in operation), the Phœnix Iron and Steel Works, and the Rhenish-Prussian Colliery (special appliances for dressing coal); to the blast furnaces, rolling mills, and steel works of Gutehoffnungshutte; to the Grillo Funcke Company's Plate Mills, the Wire Works of Messrs. Bocker and Company, and the collieries of the Consolidation and Gelsenkirchen Mining Companies; to the Bochum Iron and Steel Company's works (blast furnaces, rolling mills, Bessemer, &c., steel works, and collieries); to the Union Dortmund Company's works (blast furnaces, rolling mills, and steel works); and to the Horde Company's works, where the basic process of steel-making will be witnessed. The address of the secretary (Mr. J. S. Jeans) is Tonhalle, Dusseldorf.

Agricultural Exhibition, Montreal.—The Dominion of Canada Agricultural and Industrial Exhibition will be held at Montreal from September 14th to 24th, 1880. Prizes, to the amount of 20,000 dollars, are offered for live stock and poultry, dairy and agricultural products, implements, machinery, manufactures, fine arts, ladies' work, &c., and a prize list has been published.

Pneumatic Clocks in Paris.—Time, says *Engineering*, is now supplied to street clocks, public offices, hotels, and private dwellings in Paris, like gas or water, from a central station, by means of compressed air conveyed through underground pipes. At the central station there is a reservoir of compressed air, and for the first twenty seconds of every minute, as given by a standard time-piece, a current of the compressed air is allowed to flow through the pipes to the receiving clocks. By means of a small bellows, which is expanded by the transmitted air, the works of these clocks are kept going at a practically uniform rate. The street mains are of wrought iron about 1 1-16 in. in diameter, and these are connected to service pipes of lead 1 3-5 in. in diameter, while the different stories of a building are supplied by rubber tubes ½ in. in diameter. Any number of clocks can be actuated in this way, within a radius of two miles from the central station, and the system has done so well in Paris that a company has been formed to introduce it into New York.

Algiers.—Algiers is increasing in popularity as a winter resort, but although the climate of the city and suburbs is usually agreeable, there are times when the cutting winds and blinding dust clouds cause invalids to desire a more satisfactory retreat, and this may be found at the Hammam R'Irah, on the slopes of the lesser Atlas Mountains, about 56 miles distant from the city of Algiers. The railway station is situated near the village of R'Irah, about 650 metres above the level of the sea. Directly beneath is the valley of the Oued-Djer. The hot and cold mineral waters for the baths and for drinking are supplied from springs in the hill sides, just behind the establishment. These waters have been found useful in cases of long continued marsh fevers, but those who with whom they do not agree, can use the fresh water obtained from a spring in the neighbourhood.

Cotton Oil.—The manufacture of cotton oil from the cotton seed, according to the *Times*, is becoming of importance in the United States, there being at the present time upwards of 41 oil mills, of which nine are in Mississippi, nine in Louisiana, eight in Tennessee, six in Texas, four in Arkansas, two in Missouri, two in Alabama, and one in Georgia. The annual quantity of seed converted into oil now amounts to about 410,000 tons, the yield being at the rate of some 35 gallons of oil to the ton of cotton material. Moreover, each ton leaves 750 lbs. of oil cake of admirable fattening qualities. A great deal of the cotton oil is imported to Italy and other countries, where the olive oil is a staple; and, in point of fact, cotton oil is there superseding the olive oil, not only for utilitarian purposes, but also as an article of food. It is said, too, that the use of cotton oil in this way is gaining ground in some parts of the States. The following are the statistics of consumption:—

	Export. Gallons.	Home Consumption. Gallons.
1876-7 ..	1,316,000 ..	2,000,000
1877-8 ..	1,457,000 ..	1,800,000
1878-9 ..	5,750,000 ..	2,425,000

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,449. VOL. XXVIII.

FRIDAY, AUGUST 27, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

LECTURE V.—DELIVERED FEBRUARY 30, 1880.

Ebonite or Vulcanite. Its manufacture. Chemical and physical properties. Applications in the useful and ornamental arts. Substitutes for india-rubber.

The fact that rubber becomes hard and horn-like, when the operation of vulcanisation is carried on to an extreme degree, was recognised by Hancock, in his earlier experiments concerning vulcanisation; but it was not for some years afterwards that the industrial importance of hard vulcanised rubber was duly recognised.

Between the years 1848 and 1850, Charles Goodyear produced some fine specimens of ornamental work, in the material in question, and these fully demonstrated the industrial value of vulcanite or ebonite; proving conclusively that the most delicately modelled objects can be faithfully reproduced in hardened india-rubber.

I am indebted to Mr. Sexton, for the opportunity of showing to you a unique collection of Goodyear's earlier specimens, these being of a character calculated to surprise some of those who judge of the possible developments of the ebonite industry, by those articles which are now met with in the ordinary channels of trade.

Hard vulcanised rubber is produced by exaggerating the conditions of ordinary vulcanisation, or increasing the proportion of sulphur added, and lengthening the period during which it is allowed to react on the rubber. The temperature at which the operation is conducted may, in some cases, be slightly elevated over the heat usually employed in the case of ordinary vulcanisation; but this course is more or less liable to lead to the production of unsound or spongy ebonite, and those who are most successful in the regular production of goods of the highest quality seldom employ a temperature above 135 to 140° Centigrade.

The sorts of rubber best adapted for the production of ebonite, are those hard and fibrous kinds which are yielded by the islands of the Malayan Archipelago; and that obtained from Borneo is generally considered to be exceedingly well adapted for the purpose in question. Rubbers of the African tongue order are not adapted for the ebonite manufacture, while the high-priced Para rubber yields an article inferior to that obtained by making use of the lower-priced rubbers first mentioned.

Before proceeding any farther, please be good enough to notice this strip of rubber, which has remained in the melted sulphur bath during the last three hours, the temperature having been maintained near 140° during the greater part of the time. It has, probably, absorbed as much as 40 to 50 per cent. of sulphur, and has altogether lost its extensibility by tension; while its colour is somewhat darker than that of ordinary vulcanised rubber.

As regards the industrial production of vulcanite, the sulphur bath method is inferior to the more certain process of mechanical admixture and subsequent curing.

The rubber intended for use in the ebonite manufacture requires careful purification, and the ordinary washing process, as already described, is occasionally considered to be insufficient. In such a case it is supplemented by a kind of deviling operation, which consists in tearing the rubber into shreds under water, after which it is soaked in an alkaline solution. The purified and carefully dried rubber is next mixed, by means of the usual heated rollers (Fig. 15, p. 774), with a proportion of sulphur, which may range from 50 per cent., when hardness is required, and a slight degree of brittleness is not considered a disadvantage to 25 per cent., when elasticity and comparative softness are wished for. It is important that the sulphur should be dry and free from acid, and that the materials should be thoroughly incorporated. About 3 per cent. of lamp-black or vegetable-black is often added, in order to improve the colour of the finished material, and a similar proportion of calcined magnesia is also occasionally added.

During the incorporation of the sulphur, the material becomes remarkably plastic, and appears to lose almost all traces of elasticity, so that it can be calendered into sheets with very great facility.

Ebonite is usually cured in steam, at a temperature of about 135° Centigrade, the operation lasting during a period of 6, 8, or 10 hours, according to the thickness of the articles or other circumstances, but if the temperature is gradually raised to 140—150, during the progress of the operation, a much shorter time may suffice. Under any circumstances, it is unadvisable to apply the full heat at once, but first to set the material, by commencing the vulcanisation at a moderate temperature.

The articles built up or made of the soft material, generally require more support during the operation of curing than is afforded by imbedding them in powdered French chalk.

In the case of ebonite sheets, the support usually consists of plates of tin, these being made by rolling together a number of thicknesses of tin-foil. By thus vulcanising the ebonite between sheets of tin, a surface is produced which is so smooth as to be almost polished, while a similar end may be attained by using glass plates for a like purpose; an extremely thin film of grease, or preferably wax, being applied to prevent adhesion.

Several distinct stages or steps may be traced during the curing of ebonite; and I wish to call your attention to some specimens illustrating these various stages.

Here, in the first place, is the plain mixture of sulphur and rubber; this being nearly white, and capable of becoming quite plastic or soft by the application of a gentle heat.

The second specimen illustrates the action of a very moderate degree of heat on the mixed material: this particular sample having been heated to 128° Centigrade for twenty minutes. It is, as you see, somewhat darkened, and has lost a little of its original softness; while a degree of heat which would have rendered the original mixture plastic, like putty, fails to make much impression upon it.

The third specimen illustrates the effect of a more prolonged heating, this sample having been heated for an hour to 135° Centigrade. It is olive green in colour, and has acquired a certain amount of elasticity, resembling that of a rather inferior quality of vulcanised caoutchouc.

The fourth stage of curing is illustrated by this specimen, which you see is brown, and tolerably hard. Ebonite in this state refuses altogether to become plastic by heat, and a temperature of 150° maintained for half an hour or less would suffice to bring it to the fifth stage, or that of finished ebonite.

The fifth stage, or that of properly-cured ebonite, is the goal to be arrived at in manufacturing the material. There should be no places where the curing is imperfect, a kind of defect which is likely to happen when articles of unusual thickness are vulcanised, and no portion of the ebonite should be spongy or honey-combed by air bubbles.

The sixth, or spongy state, is generally the result of overheating, bubbles of gas forming in the material, and converting it into a kind of porous cinder-like mass.

A specimen will now be handed round, which illustrates the third, fourth, fifth, and sixth stages, as already described. The specimen in question was cured on a hot-plate, this having probably been heated to 160° or 170° Centigrade; and you will be able to trace all gradations in the curing operation, from the first setting of the plastic material to the destruction of the ebonite by overheating.

A study of the sample in question points very clearly to the propriety of curing ebonite at a low temperature, especially when articles of considerable thickness are operated upon; as the long continued moderate heat tends to ensure equal action through a considerable mass. Very small or thin articles may be cured rapidly without much chance of mischief arising. It very often happens that when thick articles are required to be made of ebonite, it is found convenient to build them up layer by layer, and cure each before adding another. New material adheres very perfectly to old, and unites thoroughly during vulcanisation, provided that the old has not been so far cured as to become extremely brittle, and that it is well roughed up before the fresh material is applied. A little of the mixed, but uncured, ebonite may be softened by benzole, and well rubbed over the place where additions are to be made.

The working of the soft, mixed ebonite, before curing, is a very easy matter, as it can be moulded into any form, and pieces of it may be united by warming the edges, or by smearing them with a solution or paste, made by dissolving some of the mixed material in benzole.

Moulds of tin, of brass (tinned inside), or of type metal, answer very well; the application of a trace of oil, followed by a thorough brushing with black lead, being an effectual preventive of adhesion between the finished material and the mould. In building up complex articles of ebonite, the usual method is partly to vulcanise or cure the main portion, bringing it, say, to the fourth stage already mentioned, and then to make the required additions. Many articles can be advantageously cured in moulds of plaster of paris; and I believe that several of the finely modelled specimens of Goodyear's work, now before you, were made in plaster moulds.

Casts of phototypic reliefs can be made of ebonite; the mode of procedure being quite similar to the making of the soft india-rubber casts (p. 787). One or two of these, together with the type-metal moulds, and the corresponding negatives, will now be handed round. Tubes are generally made on mandrils, the soft ebonite being wrapped round these, and then supported by a wet cloth bound over.

When ebonite is heated to a temperature of about 100° Centigrade, it can be bent to a certain extent, as the heated strip serves to illustrate; and, on cooling, it retains the form given to it. The spiral bracelets which you see on the table are manufactured straight, and afterwards bent while warm. In a similar manner an ebonite disc, when slightly warm, may have a device struck upon it coin fashion. This can be very well illustrated by means of the small striking press which is now before you. Notice how readily the warmed ebonite takes an impression of the die, but the pressure required is considerable, and the device is not very permanent, as on warming such a coin or medal, the ebonite recovers from the state of tension into which it was put by the operation of coining, and the image disappears. The Silvertown Company manufacture large numbers of ebonite coins and tokens, these being principally made use of in the South American States, and a collection of these is now before you. These coins are struck up by repeated blows, produced by a press so constructed that one spoke of a loose fly wheel, which is worked by hand, shall strike against a driver attached to the screw of the press. This arrangement renders it easy to force down the screw by a series of blows. Let me now heat a few of these coins over the flame of a gas stove, after which the resulting plain discs shall be handed round, together with coins similar to those which were heated.

You understand, then, that in the case of these coins, the low level parts exist in a state of compression, and are ready to rise up to the level of the other portions as soon as the application of heat enables the molecules of ebonite to take a position of equilibrium. Consider now the effect of planing one of the coins, so as to reduce the projecting points to the level of the compressed parts; and then heating the blank thus obtained. You shall see for yourselves, Here are some coins which have been so rubbed down, or planed. On heating them the compressed parts rise up, and the device reappears in *intaglio*, with all the detail of the original. We have, in fact, a reproduction of the original die, only it is reversed as regards direction —the left hand becomes the right, and *vice versa*.

Here is a coin, one side of which has been rubbed down level, while the other side is untouched, and on heating this the device will disappear from one side and re-appear in *intaglio* on the other side.

The property of ebonite just illustrated may have a practical application in this way. It is often desirable to obtain quickly a reversed reproduction of a printing block, and this may be done in the following manner:—The block is forced against a sheet of ebonite, this being slightly warmed, so as to obtain a sunk impression; and the ebonite plate is next planed off level, or rubbed down by an abrading material, after which it is exposed to a heat of about 140° Centigrade. The compressed lines now rise up and form a printing block, which is an exact reproduction of the original, only it is left-handed or reversed, and to fit it for printing it is only necessary to deepen the widely-extended whites by means of the ordinary wood engraver's tools. Ebonite forms very good printing blocks or stereotypes, these being made just as in the case of the soft rubber stamps (p. 787).

You see before you this evening, a very fine collection of articles, manufactured from ebonite, these not only serving to illustrate the manifold uses to which this material is applied in connection with the industrial arts, but also to exemplify the variations which may be produced in the material itself, as regards hardness and elasticity, by varying the composition of the original mixture in accordance with the principles already explained. In the case of specimens lent by the Silvertown Company, you see a number of small articles of exquisite finish, and you will not fail to notice the collapsable drinking-cup for travellers. Messrs. Cow and Co. have lent me two extremely fine specimens of vulcanite work, one being a what-not, consisting of thick slabs of ebonite, supported by turned columns of the same material, and the other being an inlaid slab, built up of a kind of mosaic, formed out of variously coloured pieces of vulcanite, and you will notice that some of the pieces are nearly white. The conditions under which nearly white and coloured vulcanite can be obtained will be described further on. Mr. Falkenstein, of the Britannia Rubber and Kamptulicon Company, has brought me some admirable specimens. You will notice the thin ebonite sheet, almost like paper, which this firm manufactures, and also the extensive selection of fancy and ornamental articles, these being, for the most part, made after Mr. Falkenstein's own designs. Here is a reproduction of a medal which has been moulded in vulcanite by Macintosh and Co., of Manchester.

Ebonite works very much like horn or ivory, and can be very readily turned at the lathe, but a high rate of speed is required. A finish can be given to the articles by the use of flour-glass paper, followed by the 000 emery paper used by watchmakers, after which a final polish can be rapidly given by the arrangement to be described. A number of rough pieces or discs of cloth are clamped, circular-saw fashion, on a spindle, and this is made to revolve at a very high rate of speed—say about 4,000 revolutions per minute. This polisher being slightly charged with fine brick-dust and water, oil, or paraffin, the articles to be polished are held against it, when they soon receive a high degree of polish. Rotten-stone may also be used on a polisher of this kind; and one considerable advantage attending the use of the polishing apparatus in question, is the ease with which variously shaped articles may be operated upon.

Small flat articles may be very readily polished by rubbing them on blotting paper charged with tripoli or rottenstone. Many metals, especially iron, may be imbedded in soft ebonite and fixed very firmly by vulcanisation; and advantage is taken of this circumstance in many cases. Thus the handles of steam and hot water cocks may be advantageously clothed with ebonite, and iron screws may be fixed into ebonite insulators in a like manner. Again india-rubber rollers are usually fixed on to their iron spindles by means of a layer of ebonite placed next to the metal; the ebonite and the soft rubber adhering perfectly, while the ebonite adheres well to the iron, especially if the metal is somewhat toothed before the application of the soft material.

To give anything like a list of the applications of ebonite to the industrial arts would be impracticable, but its more important uses are illustrated by the specimens before you. The characteristic properties on which its usefulness principally depends are its hardness, elasticity, electrical non-conductivity, freedom from porosity, and its inertness towards most chemical products.

Vulcanite may be obtained in a coloured form, by incorporating with it a large proportion of certain pigments, such as ultramarine, vermilion, sulphide of cadmium, sulphide of antimony, or oxide of chromium; while, if it is required in as nearly as possible a white state, oxide of zinc and sulphide of zinc may be used. When these pigments are incorporated, there is not the same necessity for pushing the vulcanisation to such extremes as when rubber and sulphur alone are employed, as the pigments themselves give a certain degree of hardness. In such cases the proportion of sulphur, in relation to the rubber, may be very much reduced, and it is generally sufficient to carry on the curing to a point between the third and fourth stage, as already defined. At this point the rubber has a brownish, or dark olive green colour, but the presence of a large proportion of pigment serves to mask this.

Dental rubber, the material used for setting or mounting artificial teeth, consists of a highly pigmented vulcanite, made to imitate the natural colour of the gums. There are on the table some very fine samples of the material in question, and for a portion of them I am indebted to Mr. Sangster, the representative of the New York and Hamburg India-rubber Company.

Dental rubber forms a very convenient material for the making of various small articles, and it may be readily cured in the small vulcanisers which were shown you on the occasion of the third lecture. (Figs. 20, 21, and 22, p. 779.) When it is desired to have a dental rubber, which can be rapidly cured, the following composition will serve:—

Washed Borneo rubber	25
Vermilion containing 33 per cent. of free sulphur	30
Powdered sulphur	5
Sulphide of zinc	20
Sulphate of strontium	20
	100

It is, however, better, if colour and quickness of curing are not very primary objects, to approximate more nearly to the composition of ordinary ebonite. As for example:—

Rubber	45
Vermilion, as above	20
Sulphur	15
Sulphate of strontium	20
	100

A small portion of fine gutta-percha may be incorporated with the material for dental rubber, the result being advantageous in many cases; and shellac is occasionally added to the materials for ordinary ebonite.

The turnings and dust of ebonite may be compressed in hot moulds, so as to form buttons or other small articles, or these residual products may be mixed with new rubber and sulphur to form a second quality of ebonite.

When ordinary vulcanised rubber is heated to 230° Centigrade, or until it melts, a permanently viscous product is obtained, and this substance, if mixed with emery and sulphur to a kind of paste, forms a material out of which the so-called agglomerated emery wheels or grinders may be formed, the mixed materials being next hardened or cured by the application of a steam heat. Emery wheels and hones made on this principle were introduced by Deplanque, about 23 years ago.

Thirty-five parts of old vulcanised caoutchouc having been placed in a kind of still, heat is applied to melt it, the operation being assisted by the gradual addition of about ten parts of heavy coal oil; but this latter is afterwards distilled off. The softened caoutchouc is then incorporated with 500 parts of emery of the required degree of fineness, and nine parts of sulphur. These materials having been thoroughly mixed, the bones or wheels are manufactured, and afterwards cured or baked at a heat of 140° Centigrade, during a period of about eight hours. Grinding wheels, made in the above manner, can be worked at a speed of 2,000 revolutions per minute, and are extremely useful for the working of hardened steel or other obdurate materials. Some of the wheels, and also some knife sharpeners, are now on the table before you.

The substitutes for india-rubber are of comparably little importance in relation to caoutchouc itself. Oxidised linseed oil is occasionally used in the making of flexible tubes for leading gas or for surgical purposes; indeed, I should rather say, for waterproofing such articles after they have been built up of fibrous materials. Such tubes, of which several specimens are before you, are far inferior to rubber tubes in most cases, and are formed by repeatedly varnishing the fibrous base with a carefully prepared linseed oil varnish.

Vulcanised oil is, perhaps, of more interest, and many oils, such as linseed and others resembling it, may be vulcanised by being heated for some time to 150° Centigrade with 12 to 20 per cent. of sulphur. The product obtained is soft, and somewhat resembles very bad india-rubber. By increasing the proportion of sulphur very much indeed, say to four times the weight of the oil, and vulcanising at a higher temperature, a hard substance, resembling inferior vulcanite, is obtained.

Soft and hard vulcanised oil have been introduced into commerce at various times and under many names; but these materials never seem to have made very much headway.

Various products, having pyroxyline or soluble gun-cotton as their basis, have been introduced as substitutes for hardened caoutchouc. Parkesine, a substance made by incorporating pyroxyline and linseed oil, forms a material well fitted for the manufacture of knife handles or similar articles; and I will now hand round a very beautiful specimen, which is well worthy of your notice.

The substance now known as celluloid, which consists essentially of pyroxyline and camphor, appears, however, to have characteristic properties which will enable it to fulfil certain purposes for which vulcanite is ill-adapted.

A solution, containing about equal parts of camphor and tetrachloride of carbon, dissolves or softens pyroxyline very readily, and if such a solution is incorporated with a sufficient proportion of the soluble nitro-cellulose, a dough-like mass is obtained, which hardens on the evaporation of the tetrachloride of carbon; but the material may be again made plastic and workable by being heated to a temperature between 100° and 125° Centigrade.

Many other methods of incorporating camphor with pyroxyline or nitro-cellulose may be adopted; as, for example, the mere mechanical admixture of the materials at a carefully-regulated temperature. Again, the camphor may be dissolved in carbon disulphide, liquified sulphurous acid, or other solvents. Celluloid may be, and often is mixed with resinous substances or colouring matters.

Another celluloid-like body, due to the ingenuity of Mr. Parkes, of Birmingham, is obtained by softening nitro-cellulose by means of alcohol, and forcing the product into moulds. This substance is exceedingly tough, while it has the advantage of being free from camphor, and is capable of resisting the action of heat to a considerable extent.

Celluloid and analogous products have the disadvantage of being very inflammable, and instances have been known of these bodies igniting by percussion.

Buttons, combs, billiard balls, and other similar articles are made of celluloid, the soft material being usually forced in iron or steel moulds. Most wonderfully perfect stereotypes may also be made of the material in question. Celluloid is also coming much into use for making artificial gums or bases for teeth.

MISCELLANEOUS.

THE PERKINS ENGINE.

The following is the report of Mr. F. J. Bramwell, F.R.S., to the directors of the Perkins Engine Company, dated June 28, 1880, giving the result of a trial of the engines of the yacht *Anthracite*: —

In accordance with your desire, as communicated through Mr. Loftus Perkins, I, on Saturday, the 22nd May, made a trial of the Perkins patent engine, fitted on board the screw steam yacht *Anthracite*, preparatory to her leaving England on her voyage to New York.

You are, of course, perfectly well aware of the nature of the engines and boilers of the *Anthracite*, but in order that this report may be more readily followed, I think it well to state, in the report itself, the leading particulars of the machinery of that vessel.

The engines are of the direct-acting inverted type, with surface condensation. Two cylinders only are used, but the after cylinder has two diameters of bore; the upper, the smaller one, is the high pressure, and receives the steam from the boiler during the first half of the down stroke, the lower, the larger diameter, is the medium or intermediate, and is supplied at the up-stroke with the steam, which, in the high pressure, did the work of the preceding down stroke. The exhaust from the bottom of the after cylinder passes into a chamber, from which is afforded the supply to the low-pressure (the forward) cylinder; from this arrangement there is obtained in two cylinders an expansion of thirty-two times.

The distribution of the steam in the after cylinder is made by three lifting double-beat valves, the upper faces of these valves being, however, divided into two sections. The valve stalks rise and fall by the action of eccentrics, which control the motion of the stalks downward as well as upwards, the stalks being loose in close-topped sockets in the valves, so that after the valves are seated the stalks can recede from them. The distribution of the steam to the low-pressure cylinder is made by an ordinary slide valve with an expansion valve on its back; this latter valve is worked off the prolongation upwards of the circulating pump-rod. The surface condenser is composed of a number of close-topped, galvanised, wrought-iron tubes, standing vertically from a tube-plate, and having within them smaller tubes open at both ends, and proceeding upwards from a lower tube-plate, so that the water from the sea passes up through the central tubes, and down the annular spaces to the inlet of the circulating pump.

The exhaust steam is admitted into the body of the condenser, and comes into contact with the exterior of the close-topped tubes, the condensed steam being drawn off by the air-pump, and returned to the hot well which surrounds the upper part of the condenser. The space between the high-pressure piston and the upper side of the intermediate piston is in connection with the chamber which supplies the low-pressure cylinder. The circulating pump is worked by a beam off the low-pressure piston-rod, and the air-pump is worked by a similar beam off the intermediate cylinder piston-rod. The feed pumps and bilge pumps are worked off the cross-heads of the circulating pump and of the air-pump. The reversal is effected by a link motion.

The cylinders and their covers are heated by steam, circulating through wrought-iron pipes cast into the thickness of the metal, and are very efficiently cleaded so as to prevent loss of heat.

The boiler is the well-known Perkins boiler, formed of successive horizontal rows of wrought tubes (3 in. external diameter), connected at frequent intervals by vertical thimbles, the whole series being contained in a wrought-iron double casing, having the space filled in with vegetable black. The water gauges, one in the boiler and one in the engine-room, are made of flat plates of mica secured in frames. The boiler is supplied with distilled fresh water. There is a still fitted with a coil, and having its steam-pipe in connection with the condenser, by which the store of water can be distilled over for use.

With respect to the dimensions of the engine, I was furnished at my request by Messrs. Hawks, Crawshay, and Sons, the builders of the engines, with the working drawings. These drawings show the high-pressure cylinder to be 8-in. bore, the intermediate 16-in. bore, and the low pressure 23-in. bore, but I was informed by Mr. Perkins that the cylinders were all somewhat smaller than the foregoing dimensions. He has now sent me the gauges, and these give the high-pressure cylinder at $7\frac{3}{4}$-in. diameter, the intermediate as $15\frac{1}{16}\frac{3}{8}$-in., and the low-pressure as $22\frac{1}{16}\frac{3}{8}$-in. The stroke in both cylinders is 1 ft. 3 in. The diameter of the piston-rods (the areas of which have to be deducted from the area of the intermediate piston, and from that of the under-side of the low-pressure piston) is $2\frac{3}{4}$-in.

My principal assistant was on board the *Anthracite* on the Friday, and he informed me that the fire was let out at about 2.30 p.m. on that day, and, as the result, the boiler and water were practically cold when the fire was lit on Saturday morning.

Preparations for the trial had been made by weighing out 50 cwt. of "Nixon's navigation hand-picked lumps" into fifty 1 cwt. sacks. These were ranged on deck. The bunkers, which were full, were sealed up both above and below. A spring balance was hung up on deck, close to the stokehold hatch, and one of my assistants caused each sack of coal to be re-weighed just before it was lowered for use. The gross weight was taken, and the sacks were afterwards separately weighed, so as to obtain the net weight of the coal.

Fifty pounds of dry wood were served out, and two sacks of coal, and with these the fire was laid (the grate has an area of about 15 square feet). The fire was lit at 6.28 a.m. Steam was up and the engines were turned round at 7.18 a.m. The height of water in the boiler guage was noted, and also the height in the hot well, the still cock being shut, was sealed in that position. The steam stop valve was sealed in its wide open position. The engines were started, and the vessel got under way at 7.20 a.m. The throttle valve was put into the position which the engineer knew, from experience, would cause the engines to run at about 130 revolutions per minute, after they became thoroughly heated up, and the handle was sealed into this position, the link motion being in full gear ahead. The engines were provided with a Harding's counter, such as is used in the Navy, and there were pressure gauges to show the boiler pressure, and the pressure in the chamber supplying the low-pressure cylinder, and the condenser was provided with a vacuum gauge, Four Richards' indicators were fitted, viz., one to the high-pressure end of the after cylinder, one to the intermediate end of that cylinder, one to the top and one to the bottom of the forward, the low-pressure cylinder.

The first set of diagrams was taken at 8.22 a.m. The first reading of the counter at 8.30 a.m. From this time until 5.45 p.m., the counter was read at the hours and half hours, and sets of diagrams were taken at the quarter past the hour, and at the quarter to the hour. The time when each sack of coals was lowered into the stokehold was noted, and also the time when the stoker commenced to use the contents of each sack.

The last shovelful of the 15th sack was put on at 5.18 p.m., and it was decided to stop the trial as soon as the coal then in the fire was exhausted.

I determined to let the engines run on until they stopped of themselves, and to take indicator diagrams, first at each quarter of an hour, and then at each five minutes during the time they were gradually stopping. The quarter-hour diagrams were taken until 6.30 p.m., when the engines were making 124 revolutions, and the five-minutes diagrams were taken until the engines came to a stand at 7.23 p.m., or 12 hours 3 minutes after their start in the morning. The water in the boiler was pumped to the same level in the guage as that at which it had stood in the morning, and the height of water in the hot well was noted.

The mean revolutions from 8.30 a.m. to 6.30 p.m., 10 hours, were 130·77 per minute, and from the first start the same time being 11 hours 10 minutes, the mean revolutions were 130·4 per minute.

An experiment was made as to the transmission of heat through the boiler casing. This was carried out by placing the bulb of a thermometer in contact with the top of the casing, the bulb being covered over with

cotton waste; the result was that at the end of one hour the thermometer stood at 125 deg. Fahr.

From the start at 7.20 a.m. to 6.30 p.m., 11 hours and 10 minutes, the engines developed an average gross indicated horse-power of 80·55, but from 6.30 to the time, 7.23 p.m., that the engines stopped of themselves from the fire having burnt itself out, the power was of course gradually diminishing. This being so, I have calculated the whole work from first to last in foot-pounds; these amount to 1,828,291,466 foot-pounds, equivalent to 923·38 horse-power, if exerted for one hour.

	lb.
I estimate the 50 lb. of wood as of about one-third the value of coal as fuel, say	17
The coal, 15 cwt.....	1,680
	1,697

The gross indicated horse-power developed during the trial being equivalent to 923·38 horse-power, exerted for an hour, 1,697 ÷ 923·38 = 1·83 lb. of coal per horse-power per hour, including the coal used in getting up steam.

As a check upon the foregoing, from the time when the first shovelful of the fourth sack of coals was put on the fire, namely, at 7·50 a.m., to the time when the first shovelful of the 15th sack of coals was put on the fire, namely, 4.45 p.m., *i.e.*, 8 hours 55 minutes, the engines exerted an average of 80·9 horse-power; this gives the consumption per horse-power per hour at 1·7 lb., assuming the fire was uniform at the commencement and end of these times. The loss of water for the whole 12 hours was 23½ gallons.

The engines worked with the most remarkable smoothness and regularity, as with the exception of tightening up the bolts of two glands about an hour after the start, there was not a spanner or hammer or any tool used about the engines during the twelve hours the ship was under way, nor was there a single handle connected with the engines shifted. The link motion was in full gear the whole while, and the stop valve and throtter valve remained as I have said, sealed up and unmoved.

Water was allowed to circulate on the thrust block, but there was not a heated bearing anywhere. The amount of lubrication was small, involving an expenditure of about one gallon of lard oil, while cylinder and slide lubrications are, in the Perkins system, inadmissible, and, with the metal used, unnecessary.

The engines were thoroughly steady, no straining or racking of any kind; in fact, it is impossible for any pair of engines to have worked in a more thoroughly satisfactory manner, so far as all external evidence of working was concerned, and there were no sounds to lead to any other belief than that of all being satisfactory within.

I hope, on the return of the *Anthracite* from America, to have an opportunity of seeing the engines opened, and of thus observing their condition after some thousands of miles of steaming, and I should also be glad to have an opportunity of re-testing the consumption.

At the conclusion of the trial my assistants took away the four indicators and the spring balance with which the coals were weighed. All these have been tested, with the result that the balance and the 100 lb. spring (used in the high-pressure cylinder indicators), and some of the lighter springs, are absolutely accurate, and that the variations in the others are too trifling to call for any allowance in calculating the mean pressures

It may be well to state that the mean pressures of the various diagrams (of which there were 128 in all) have been ascertained by dividing the areas of the diagrams, obtained with the planimeter, by the lengths of the diagrams. This is a thoroughly accurate mode, while the plan commonly followed by measuring the heights of the diagrams at a number (usually ten) of places, is one which ordinarily gives a pressure in excess of the truth.

It would be an investigation of considerable interest, in an engineering point of view, if a vessel, fitted with first-rate compound engines of the ordinary construction, and working, say, at 70 lb. pressure in the boiler, and indicating something about the same power as those of the *Anthracite*, viz , from 70 to 90 horse-power, could be tried in a precisely similar manner to that in which the *Anthracite* was tried.

In conclusion, I wish to say that I esteem myself particularly fortunate in having obtained the friendly co-operation, during the run, of Mr. William Rich, of Messrs. Eastons and Anderson, whose long experience in engine trials rendered his assistance of the greatest value, and to whom I beg leave to express my best thanks. I have his authority for saying that he entirely concurs in this letter of report.

(Signed) F. J. Bramwell.

TREES IN KENSINGTON-GARDENS.

In answer to **Mr. Ritchie's** questions, in the House of Commons, on the 19th inst., as to why so large a number of trees in Kensington-gardens were being cut down, and as to what extent it was proposed to carry out the operation,

Mr. Adam, the First Commissioner of Works, said—I am very glad that the hon. gentleman has asked this question, as the forms of the House would not have given me an opportunity of explaining what is now being done in Kensington-gardens, and as the matter is very likely to be misunderstood by those who have not carefully watched the gradual decay of the trees in that park, which decay has become rapid and decided in the last two years. Hon. gentlemen who were in the House when the vote for the parks came on, may remember that I then observed how many of the trees in Kensington-gardens were either dead or hopelessly dying, and how necessary it had become that some decided action should be at once taken with regard to them. The natural decay, owing to impoverished soil, and terrible neglect of timely thinning fifty or sixty years ago, had been much aggravated by the hard winters and the cold and wet summers of the last few years. In the more thickly-planted portions of the gardens, the trees were dead and dying in hundreds, and in all parts the dead trees were very numerous. I had made up my mind what course ought to be pursued, but knowing the sensitiveness of the public regarding tree-cutting, and being aware how averse people generally are to that free and bold use of the axe which is of the essence of good wood management, I thought it advisable to ask the co-operation of a small committee of experts, who might give their advice, and support me by their authority. I applied accordingly to Sir Joseph Hooker, Mr. Clutton, Mr. Thomas, so distinguished as a landscape gardener, and to my right hon. friend the late First Commissioner of Works. These gentlemen all agreed to assist me, and several meetings have been held in Kensington-gardens with me and Mr. Mitford, the secretary of the Office of Works, who is himself eminently qualified to give a sound opinion on the subject. The result has been a unanimous resolution that we ought to proceed at once to clear away the dead and dying trees. This is now being done. In some places an absolute clearance has had to be made, and all over the gardens numerous trees are being removed. The spaces cleared will either be trenched, drained, and replanted, or will be left open, as may appear best. At present any one who has not studied the subject, or carefully observed the trees for some years past, may think that too much is being done; but I can assure the hon. gentleman and the House that the utmost care is being used in the work; that not a tree is being cut

that can properly be spared; and that every effort will be made to restore life to the distinguished trees which are dying. I may say, speaking with the authority of the committee, as well as from considerable personal experience, that this work has not been begun one moment too soon if the beauty and enjoyment of Kensington-gardens are to be properly preserved.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The third general report of the school, dated Easter, 1880, but only now issued, is as follows:—

The committee of management have the honour to submit, for the information of the founders of scholarships and subscribers generally, the following brief report on the condition and proceedings of the school during the past year:—

Scholars and Private Students.—The body of scholars has undergone some slight changes during the year; *e.g.*, four scholars have resigned their scholarships, two to devote themselves entirely to their profession, one to be married, and one to continue her studies at Leipsic; and one has forfeited her scholarship by irregularity of attendance and by failure in other respects to comply with the rules of the school. Three of these scholarships have been conferred on new scholars, the other two are still vacant. Two scholarship have been cancelled by their respective founders, and the scholars withdrawn for want of means to maintain them. On the other hand, five new scholarships have been founded, viz., three by the town of Birmingham, one by the Cloth-workers' Company, and one by Mr. Nelson. The number of scholarships is now, therefore, ninety-three, of whom twenty-four are held by males, sixty-seven females; and, as has been already said, two are vacant. Arrangements were made at the beginning of the present school year for the admission of private students for periods of not less than a year, on payment of £40 in advance, from year to year. Such students are entitled to the same privileges, are taught by the same professors, and are subject to the same discipline as the scholars. Previous to admission their musical abilities are tested by examination. Of this class of students fifteen have been admitted, viz., nine females and six males. The total number of students is thus one hundred and eight.

Attendance, Conduct, and Studies.—The attendance of the scholars, save in cases of sickness, continues to be regular and punctual, and their general behaviour is very satisfactory. The instruments and subjects of study are, of course, substantially the same as they were at the time of the issue of the last report. At present fifty-two scholars are cultivating the piano as their principal subject of study; thirty, singing; twelve, the violin; and four, the organ. The pianists take singing, violin, organ, clarionet, or violoncello for their second studies; while the vocalists, violinists, and organists are compelled to study the piano. All the scholars continue to attend the harmony and choral classes, and all those who are competent for it have instruction in counterpoint and composition. During certain terms there are periodical concerts in which all the scholars in turn take part.

First Public Concert.—The first public concert of the students was given at St. James's-hall, on Monday evening, 23rd June, 1879, under the patronage of her Majesty the Queen, and under the patronage and in the presence of their Royal Highnesses the Prince and Princess of Wales, the Duke and Duchess of Edinburgh, Prince and Princess Christian, Prince Leopold, the Duke and Duchess of Cambridge, Princess Mary Adelaide, Duchess of Teck, and H.S.H. the Duke of Teck.

Terms of Study and Examinations.—The period embraced by the present report includes three school terms, viz.:—The Midsummer and Christmas terms of 1879, and the Easter term of 1880. At the end of the Midsummer term the third annual examination of the students took place. The professional examiners were represented by Sir Julius Benedict, Sir George Elvey, and Professor Ella. These gentlemen were assisted in their duties by the Board of principal professors. The reports of the professional examiners were considered to be very satisfactory, their nature being sufficiently indicated by the following extract from that of Sir Julius Benedict:—"It is with the greatest satisfaction that I am able to speak of the remarkable and in some instances surprising progress of the pupils since I had last heard them. It is evident that in a comparatively short time, talent of a high order has been discovered, which, after its full development, cannot fail to be appreciated by the public, and to be of the greatest advantage to this excellent institution." The ordinary terminal examination was held for the Christmas term, 1879, on Thursday and Friday, the 18th and 19th December, by the Board of Professors, assisted by several of the professors. On this examination, Dr. Stainer, the acting principal, reported:—"I consider the progress of the scholars very satisfactory. No case came before me in which I could trace an absence of improvement, while in nearly all cases the progress was remarkable." The Easter examination took place on Friday, Saturday, and Monday, the 18th, 19th, and 22nd March, 1880. It was conducted by the Board of Professors, in conjunction with several of their colleagues, and was considered to indicate gratifying progress on the part of the students.

Donations and Loans.—A grand piano by Erard, and a small collection of music have been generously presented by Mrs. Fletcher Bennett. Messrs. John Brinsmead and Sons are manufacturing a concert-grand piano, which they have designed for the special use of the school. The Corporation of the Albert-hall continue most munificently to permit the school to use one of their theatres for choral and orchestral practice and for examinations. The great firms of pianoforte manufacturers, Messrs. John Broadwood and Sons, Messrs. Chappell, Messrs. Collard, and Messrs. Kirkman, also still most liberally afford us the gratuitious use of their excellent pianofortes.

Efforts to Augment the Educational Facilities of the School.—The negotiations into which the authorities of the school entered, at the invitation of the Prince of Wales' Committee, with a view of uniting their institution with the Royal Academy of Music to form the nucleus of a great musical institution more adapted to the wants of the country than any existing school, having fallen through, the Committee of Management have to consider what steps should be taken for the maintenance of the school after Easter, 1881, the period when most of the scholarships will lapse.

A notice of the subsequent action, which resulted in the presentation of a petition for the grant of incorporation to the Royal College of Music, will be found in the number of the *Journal* for July 23rd, 1880, p. 752.

LONDON WATER SUPPLY.

The Earl Fortescue, on Monday, 16th inst., called the attention of the House of Lords to the report on this subject, by the Select Committee of the House of Commons. After relating the circumstances which early led to the attention he had given to the sanitary condition of the population, and especially to the supplies of water to the wage classes some forty years ago, when he saw *in situ* the evils of stagnant detention in cisterns on the intermittent system, he observed that the population of the metropolis were unfortunate in the Governmental and administrative dealing with their interests on this subject. In 1850, after the report of the first General Board of Health, the principles of which had been applied in provincial cities and foreign capitals, viz., a system of constant supply

and direct delivery without cisternage, hydranting all the streets for protection against fire, and with supplies from spring sources, instead of river sources; all under a public trust; the capital invested in water supply was six millions; and the works might then have been had for less than six millions, the amount of the capital then expended upon them. At that time there was no doubt, that, whilst the shareholders might have been compensated on fair principles, the economies derivable from unity of administration would have sufficed to have effected the main sanitary requirements of the population, including the supply of pure and drinkable water, as well as the service pipes and the removal of all the fouled water. In 1874, a Committee of the Society of Arts was appointed to investigate the means of preventing or reducing the spread of fires, a topic which necessarily involved the whole subject of water-supply. That committee, with leave, examined the specialists, the chief Government officers of the Local Government Board. The committee, very much on the evidence so derived, framed a scheme, which was embodied in a Bill brought forward by Colonel Beresford. That Bill provided for placing the whole of the water supplies in a public trust, very much as proposed by the first General Board of Health, and was submitted to the Local Government Board, and was adopted as regards all its most important features, by the former President of that Board (Mr. Sclater Booth). No doubt, if the measure had been allowed to remain in that competent department and in his hands, it would have been brought forward long ago, satisfactorily for the consideration of Parliament. But, unfortunately, from a change of administrative treatment of an anomalous character, it was not allowed to remain with him, or in charge of that department. The measure was essentially a sanitary measure, and the proper subject of the special sanitary department which had grown up, however rudimentarily, into the Local Government Board, which, in order to prepare, or to aid in the preparation of such measures, had a staff of officers specially qualified for this duty, as sanitary engineers, medical officers of health, and other officers. The chief sanitary engineer of this department—a member of the Institution of Civil Engineers—was distinguished as a specialist in the work of water supply, as having himself executed successful works in a number of towns, on the sound principles elaborated by the first General Board of Health. This officer had also sat on a Commission of inquiry on the existing London trading water companies. He, and the department, were assisted by a Water Examiner for the metropolitan water supplies, and also by an auditor of the expenditure of the companies. The chief sanitary engineer also happened to be specially conversant with the purchase of trading water companies by towns to put them into public hands; and it was due, as a matter of justice to him and the department, and pertinent to the immediate subject, to add that the principles and practice advised by him, and sanctioned by his chiefs, had given general local satisfaction. On the other hand, there was the old Home Department, not of sanitary administration, but chiefly of police, and penal *quasi*-judicial administration, with legal duties and appropriate legal officers, but no longer with any sanitary duties left, or staff of sanitary officers whatsoever. Strange to say, to the head of this non-sanitary department was confided the preparation of this great sanitary measure. It was said to be given to him because the measure was large, and he was a Cabinet Minister. But would a naval or military measure be assigned to the Lord Chancellor because he was a Cabinet Minister? The commentary on this strange course of proceeding was that, instead of elevating, it plunged the measure into deplorable blunders, the result of ignorance, and the want of proper advice. No one who had watched the public career of Sir R. Cross could doubt his great ability in dealing with questions which he understood. His successful solution of the difficult problem of the legal relations to be established between masters and servants sufficiently proved this. But neither he nor the Home-office were qualified for this particular task. Later on, and by the present Government, there were arrangements made with respect to this important branch of sanitary service, which showed how imperfectly it was understood or really regarded. There was a right hon. member of the last Government but one, a man of science, and, indeed, a specialist on sanitary subjects, who had served on the Commission for inquiring into the health of towns, and had made a very able report on the sanitary condition of Lancashire. He had been called upon, from his special knowledge, to preside over a Select Committee of the other House on the Thirlmere scheme for the supply of water to the great city of Manchester. Here, then, was the square man for the square hole. But, no; he was put into the round hole—the Chairmanship of Committees; whilst the round man, a lawyer, experienced as a Chairman of Committees, where *qaasi* legal questions have to be treated, was put into the square hole—the Presidency of the Local Government Board. Neverthless, with the aid and the advice of the specialists there, he might have avoided the errors and the costly delay consequent on the previous arrangement, assigning the measure to the chief of the non-sanitary department. It was, however, not to the President of the Local Government Board, but to the head of the non-sanitary department that this great question of the sanitary administration of the metropolis was again remitted; and it should be remembered that, great as Sir W. Harcourt's oratorical powers evidently were, he had had no administrative experience before, as he had been only one of the law officers in Mr. Gladstone's last Government. The consequence of the first default in assigning the measure to the head of the non-sanitary department, was the unadvised and alarming announcement, that large sums of money would have to be raised for the purchase of the companies' undertakings—an announcement at variance with the measure proposed by the first General Board of Health, and the measure proposed by the Society of Arts, and accepted by the Local Government Board. It was finally set aside by Mr. E. Smith, the able Government valuer, who showed conclusively, that no new capital whatever need be raised; that the existing dividends, and of future augmented dividends to which the companies were legally entitled would suffice; that nothing more than what the ratepayers were now liable to pay, would be required from them; whilst they would enjoy all the benefits derivable from the economies of consolidation, which Mr. Smith made out would amount to £170,000 a year; though the Society of Arts Committee made them out to be more than that. The next great financial error committed by the ill-advised Home Secretary was the announcement that he would take as the basis of the purchase the last value of the shares in the stock market. This created a great uproar, and it was abandoned, on the report of his valuer, Mr. Edmund Smith. But, strange to say, it was retained by his successor, the present Home Secretary, and retained, as appeared in the report, after the very effective exposure of it by Sir Edmund Beckett, who showed that the price in the market was the price that the few who were obliged to sell were compelled to take, and not the price which many who had invested, as in a trust, would, or ought to be forced to, accept. A reference to the Local Government Department for information would have shown that no such basis was ever taken in practice, or could be maintained in reason. The conclusions of Mr. Smith had been attacked on incidental grounds, the insufficiency of which had been clearly demonstrated by Sir Edmund Beckett. The absurdity of the principle became

apparent, if it was tested by application to Turkish, or Spanish stock, or any other depreciated stock in the market. The cross-examination of Mr. E. Smith, a gentleman of the highest integrity and ability, which he himself had described as like that of thief's witness at the Old Bailey; which had injured his health, and in Sir W. Jenner's opinion, probably caused the death of that much esteemed and lamented public servant, was conducted in a manner, which he (Earl Fortescue) considered quite unjustifiable. The measure certainly required a high degree of knowledge and special science; and to whom was it now proposed to leave the interests of the population of the metropolis? Why, to the Metropolitan Board of Works, whose expensive water schemes had been examined and condemned for their gross incapacity, as might be expected from a body, whose whole administration he had not very long since publicly described as "costly mismanagement;" and next to the Corporation of the City of London, whose proposals were proved to be little better; and, lastly, to representatives of the Vestries, of whose probable qualifications he could only too well judge after his experience as Member for Marylebone. It was to be hoped that her Majesty's Government would not set aside the special knowledge which it had had the means of acquiring, and would afford the House better grounds for confidence in any future measure to be presented. He concluded by asking her Majesty's Government whether, considering the injury caused to the public health in the metropolis, by the stagnant detention of water in butts and cisterns on the intermittent system of distribution, considering the excessive loss of life and property there caused by the same system, and considering the high and increasing rates paid for such water supply, the Government have offered any other terms for the water companies' works, now that the terms lately proposed have been rejected; and whether, in event of the non-acceptance of such other terms, if offered, the Government are prepared to take compulsory measures, to arrest the continuance of the evils declared by several successive Parliamentary Committees and Royal Commissions to arise from the existing conditions of the metropolitan water supply.

The Earl of Fife said that the Government was not likely to underrate the great importance of these sanitary questions, which affected in so high a degree the health of the inhabitants of the metropolis. While he fully admitted the necessity of an abundant and continuous supply of water for the protection of life and property in case of fire, he would at the same time point out to the noble Earl that the report on which his question was founded had only been published a week; and he did not think that it would be unreasonable that the Government should not be prepared to deal immediately with the vast interest involved in it. He could inform the noble Earl that the Government had not offered any fresh terms for the purchase of the existing water companies, as they had no power to dispose of the monies of the ratepayers out of which such purchases would have to be made. The committee of the House of Commons which sat upon the question of the water supply of the metropolis had recommended that a water authority should be constituted, with adequate powers to deal with the whole question. Her Majesty's Government would take measures to give effect to the recommendations of that committee.

CORRESPONDENCE.

HEALTHY DWELLINGS, AND HOW TO SECURE THEM.

The following suggestions are sent by a member:—

Before any one takes the lease of a house, or even enters one to dwell in it for any lengthened period, he should seek information on the following points, by inquiring of the lessor—

1. Is there any plan showing the system of drainage of the house and its connection with the sewers? If so, he should obtain a copy of the plan. If not, then he should require the lessor or landlord to cause one to be made. If the house is a newly-built one, the plans ought to be forthcoming, according to the law, and the local Vestry in London ought to be able to show one.

2. The tenant, before entering the house, ought to obtain a guarantee from the lessor or landlord that there is no escape of sewer gas into the house, and that the drainage is in good working order, and will be kept so by the owner.

3. If the proposing tenant can afford it, and he purposes to take a lease, he ought to employ some well known sanitary surveyor of distinction to examine and report on the drainage, as well as on the supply of water, and if the water be so disconnected with the water-closets and drainage that no effluvium can enter the cistern. The publications in the library of the Society of Arts on sanitation give the names of several authorities, who may be consulted.

4. The tenant himself can see that all drains from sinks are cut off from the sewers, and discharge themselves in the open air.

5. He should see that the water is sufficiently supplied—and that the cistern is clean and in proper working order. In every large house the cistern should be indoors, and protected from frost. He should also see that all pipes outside the house are protected from frost.

6. A most useful body of information would be collected if members of the Society were to state the precautions they have taken, and how they answered, accompanied with plans, which might be considered by the Sanitary Committee.

7. Builders might be invited to send copies of the plans they have carried out successfully, with any suggestions for discussion.

8. The Sanitary Committee might issue a short code of instructions, to be revised from time to time, according to the experience gained.

F. S.

August, 1880.

COLOUR BLINDNESS.

The paper on "Colour Blindness," which was inserted in your *Journal* for the 13th inst., contains many suggestive points, one of which I hope you will afford me space to draw attention to. Dr. Jeffries says, "I have received letters from adults, not colour-blind, whose lack of colour-names had been a serious drawback to them in their occupations in every-day life; and they have besought me to urge the teaching of colour-names and the education of colour-sense in our public schools." If such a lamentable state of affairs is in the States, it is not a bit better in England, for I thoroughly believe not one in ten of ordinary persons could correctly name the various colours, hues, and tones, especially the darker or so-called tertiary hues. Now, how is this? Because first, we have no universal standard of colours. Of all the writers on colour, be it physical, physiological, or material, but one—Symes—offers anything like a table of reference, or "colour standard." Major Ross, in his "Pyrology," gives a very extensive list of colour-names, and the various pigments to mix to produce these hues, but for want of a sheet of coloured designs, the table is practically useless for reference.

What we want is a coloured sheet, containing the more pronounced colours and hues, and give to each of these a distinctive name, always applied to that special hue by artists, painters, decorators, dyers, &c., instead

of, as now, each of the above classes having a separate colour-name for any one colour.

Secondly, we have got into this ignorance of correctly naming a colour or hue, owing to so many names being applied to a single colour. Thus the "deep gold" of the dyer is known by artists as "orange chrome," by ordinary persons as "orange," and by the mass, as a "deep yellow colour." Again, how misleading is the term "orange," for unless we specify whether it be a reddish-orange or a yellowish-orange, we might make 50 different mixtures before obtaining the right tone required. Many similar instances will occur to the reader, but my object is to point out, that, unless we adopt a universal standard of colour-names, we are as likely to be as ignorant in the future as we have been in the past, with regard to the correct application of any one colour-name.

Henry C. Standage.

Keppel-street, S.W., August 17, 1880.

RUBBER PRINTING SURFACES.

The mention of the name of Leighton in connection with rubber printing surfaces, makes me wish for the future history of inventions, to state the facts exactly.

The first attempt to produce printing surfaces was by cutting out forms of sheet rubber (several of which I have) and mounting the same for printing; a system that did pretty well for large letters. This led to type composition, and the casting from wood and metal blocks. Mr. H. Leighton being an engraver, and his brother an admirable mechanic, after costly experiments, took out a patent in April, 1864, in the name of Alfred Leighton. The first large experiments were made at Silvertown and afterwards at Streatham, which led to several other patents for printing. The first demonstration in public was at the *soirée* of the Royal Society in the same year. Attempts had been made prior to this, and patents taken out by Hancock, who essayed to produce blocks in pure rubber; which, not being vulcanised, failed. Goodyear also tried hard vulcanite for moveable type, leaving the flexible rubber stereotype, vulcanised in the mould, untouched. Very large surfaces were then obtained, and experiments made to apply them to printing, upon all substances and forms, with wonderful results, principally to those things decorated by hand or transfer. Before this, one might practically say there were thousands of things you could not print upon, and that now there are none.

Some years then elapsed, and a large commerce in small hand-stamps grew in the United States, from whence their manufacture was "exploited" all over Europe (where patent rights existed), though it must be said to the credit of the American introducer, that upon finding an English patent in existence, he made the *amende honorable* by paying £200 for a short licence, whilst those he initiated sought to repudiate all claims.

Self-inking stamps are the latest inventions, and the use of polygonal forms or facets, either as inkers or printers, is advancing, as they serve as pad stamps also equally well.

The utilisation of vulcanised "formes" for rapid printing yet remains a thing to be desired. My friend, the late Mr. Lionel Lawson, of the *Daily Telegraph*, many years ago seriously entertained the notion of applying the Patent Printing Surface, to the production of his paper, but the time taken in vulcanisation was thought to be too long, and, moreover, the paper mould came in, and this gave the curved stereo at present in use. At that period we saw the saving in ink and the small driving power required. Rubber cannot be re-cast, whilst type-metal can; it goes into the pot after serving each impression; lead soon wears, whilst, practically, rubber appears everlasting.

Every year adds something to our knowledge of Mr. Bolas's admirable subject—that wonderful gum with which you may make a sword to cut or a bandage to heal, a slab as hard as iron, or bed of air softer than down, a life-boat to live in the heaviest sea, or give a delicate device to imprint itself upon an egg-shell, with the pressure of a kiss.

John Leighton.

Royal Institution.

GENERAL NOTES.

Light Exhibition at the Alexandra Palace.—An exhibition, for the purpose of illustrating every form or means by which artificial light is produced, will be held at the Alexandra Palace, from Sept. 27 to Oct. 9, 1880. Section A. will consist of electric lighting apparatus; Section B. of gas apparatus, candles, petroleum and oil lamps, gas and oil stoves, &c.

Russian Grain.—The British Consuls at Nicolaieff and Odessa have lately dealt, in their reports, with the question of the serious competition which Russia meets with in the exportation of grain from the United States. From these we learn that last year the Russian Government sent Profssor Orbinisky, a well-known political and agricultural economist, to the United States, to report on the system there adopted for the transportation and classification of the grain. His report shows that a very different system exists throughout the United States from that in use in Russia, and he urgently recommends that some portions of the American system—specially referring to the classification of the grain into different qualities, and the general use of elevators—should be adopted at once. Consul-General Stanley remarks on this, that such is the apathy of the farmers and merchants in South Russia, that probably many years will elapse before we see these improvements, even in Odessa. "A meeting has, however, been held for the purpose of discussing these and other recommendations, which was well attended by high officials, private bankers, and large proprietors, and of which the president was Mr. Lamansky, the Director of the Imperial Treasury. Mr. Orbinisky pointed out that it was impossible at present for Russia to compete with America in the exportation of cereals, because of the suitable means of transport which existed in that country and which did not exist in their own country. In the United States the network of railways was in such close proximity that it came within 15 versts of the most distant farmer. Another thing that assisted in reducing the rate of the transport was the facilities elevators gave in the shipment of grain. After a long discussion, those present at the meeting decided (1) to interest themselves in the improvement of the rural economy of the black soil districts of Russia, so that they should not lie waste; (2) to petition the Government to unite different places as quickly as possible, so as to enliven the grain trade by a new network of railways; and (3) to interest themselves in establishing elevators and other facilities which exist in America, and which make it impossible for Russia to compete with that country."

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE INDIA-RUBBER AND GUTTA-PERCHA INDUSTRIES.

By Thomas Bolas, F.C.S.

LECTURE VI.—DELIVERED MARCH 8, 1880.

Gutta-percha. Sources. Chemical nature and physical properties. Applications in connection with the industrial arts. Vulcanisation of gutta-percha.

Gutta-percha is quite secondary to india-rubber, as regards the number of its industrial uses, but there are cases in which it could be but ill replaced by india-rubber. It differs from rubber, principally in being more readily softened by heat, in being far less porous, and in lacking that ready extensibility by tension which is especially characteristic of caoutchouc.

The *Isonandra gutta*, a fine tree, which often grows to a height of over 80 feet, and whose stem attains a diameter of three feet or more, is the principal source of the milky juice or sap which, when indurated, forms the crude gutta-percha of commerce. The *Isonandra gutta* flourishes notably in Singapore, the eastern part of Sumatra, Borneo, and Java. The lantern slide now projected on the screen (Fig. 31, p. 804), will serve to illustrate to you the appearance of the foliage, flower, and fruit of the tree in question; and next, I will show you a slide which represents the operation of collecting the juice or sap (Fig. 32, p. 805).

The *Isonandra acuminata*, also an East Indian tree, yields some gutta-percha; while the *Sapota mülleri*, or South American bully tree has, of late years, afforded a considerable supply of an excellent quality of gutta-percha, which passes under the name of "balata."

Gutta-percha appears to have been first introduced into this country by Jose D'Almeida, who, in April, 1843, presented some of the raw material, and also a riding-whip made of it, to the Royal Asiatic Society. Some months afterwards, Dr. Montgomerie presented some of the material to this Society, and a portion of it having been given to Charles Hancock, this gentleman immediately took steps to prove its applicability to various industrial purposes; and the foundation of the gutta-percha industry may be said to be due to him.

The operation of collecting the sap of the gutta-percha trees (Fig. 32) is not very different from the corresponding operation with the juice of the rubber trees. But as the gutta-percha juice sets readily, no smoking is required; it being sufficient to roll the concreting sap into rough balls or cylinders.

On the table you will find a very interesting collection of samples of raw gutta, some of which are roughly modelled into representations of animals, while others are of interest as enclosing stones, lumps of wood, and other adulterating materials. For the greater part of them I am indebted to the Gutta-percha Company of London.

The essential ingredient of gutta-percha is white, and appears to be identical, as regards ultimate composition, with caoutchouc. Faraday gives the following figures as the result of analyses of these bodies:—

	Gutta-percha.	India-rubber.
Carbon	87·2	87·5
Hydrogen	12·8	12·5
	100·0	100·0

The purification of gutta-percha can be readily effected by disolving the crude material in carbon di-sulphide, and, after filtration, evaporating the solution. Here is some carbon disulphide, and you see how readily these parings of raw gutta dissolve in it. Let us now filter the solution, and pour some on this levelled glass plate. The solvent will soon evaporate, and leave a skin or film of gutta-percha. Here is such a skin, or sheet of gutta-percha, which is now ready to be stripped from another plate, as the solution was poured on this glass about an hour ago. You see that it is nearly white, and when softened by heat, it becomes most perfectly plastic. The method of purifying gutta-percha just demonstrated, was proposed by Parkes, as the foundation of an industrial process for refining gutta-percha; but mechanical purifying methods have been generally adopted on a large scale.

Purified gutta-percha, as now shown, consists of three constituents. The most important is pure gutta, or the plastic principle; and this forms about four-fifths of the whole. Its chemical composition corresponds nearly with the formula C_{10} H_{16}, and it is perfectly white. An oxidised principle, called albane, of which a specimen stands before you, is present to a considerable but variable extent. It forms a white crystalline body, which is soluble in hot alcohol, and corresponds in composition to the formula C_{10} H_{16} O. Albane is valueless in gutta-percha; indeed, it is detrimental, being doubtless, like the body which is to be next alluded to, a product of oxidation or decay. The third constituent of the purified gutta is called fluavile, and forms a yellow oxidised resin, which is soluble in cold alcohol, and has a composition which may be said to correspond with the composition $(C_{10}H_{16})$ 2 O. It is often present to the extent of 4 to 5 per cent. in gutta-percha of good quality; while the amount of albane contained in good commercial gutta often reaches 20 or 25 per cent.

Like caoutchouc, gutta-percha is attacked by ozone with great energy; and when exposed to the ordinary conditions of the atmosphere, it

Fig. 31.



The Foliage, Flower, and Fruit of the Isonandra Gutta.

becomes oxidised and brittle with so much rapidity, that old articles made of gutta-percha are usually brittle and useless. Most liquids which dissolve caoutchouc also dissolve gutta-percha; but, in the case of the gutta, there can be little doubt that true solutions, rather than starch-like magmas, are formed.

Gutta-percha resists the action of alkaline liquids and of dilute acids, but strong and slightly warm sulphuric acid chars it readily, while concentrated nitric acid converts it into a yellow resinous body. Like caoutchouc, gutta-percha is an admirable electrical insulator, and also a very useful non-conductor of heat.

When submerged in water, or in any way protected from the action of air and light, gutta-percha has little or no tendency to change; while, on the other hand, constant exposure to light, together with alternating conditions of dryness and dampness, is most unfavourable to its well-being. The products formed by its oxidation are of a resinous nature, as in the case of caoutchouc; one of the most notable of these being a body resembling Spiller's caoutchouc resin, and

FIG. 32.



COLLECTION OF THE JUICE OF THE ISONANDRA GUTTA.

containing 27·9 per cent. of oxygen. It occasionally happens that samples of gutta are met with which resist decay in an extraordinary manner. Here, for example, is a sample of thread which Mr. Walter Hancock has had in his possession for over 20 years, and you will note that it is tough and strong like new gutta. Other samples kept under similar conditions, fell into dust as soon as they were touched; and Mr. Hancock tells me that he cannot account for the difference between them.

A temperature of 50° Centigrade serves to soften gutta-percha to such an extent that it may be easily moulded into any required form, while at 100° Centigrade, it becomes adhesive and pasty, and at 130° it may be said to fairly melt. The products of the dry distillation of gutta-percha are generally similar to those obtained by the distillation of caoutchouc.

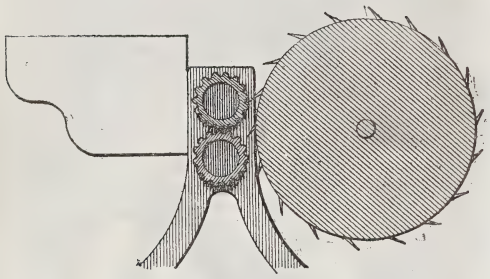
In the next place, let me very briefly call your attention to the methods employed for effecting

the purification of gutta-percha on an industrial scale, these being, in the main, due to Charles Hancock.

The first operation is to chop up the crude gutta into slices or shavings, by means of knives or cutters attached to the face of a revolving wheel. These knives are now often made with saw-like edges, each tooth being sharpened like a lancet; and it is found that the effect of this modification is to reduce the gutta into small fragments, like raspings. The finely-divided gutta is next soaked and boiled in water, in order that particles of earthy matter may sink, while the gutta floats. During this process, many particles of woody matter become so far sodden with water as to disengage themselves from the gutta and to sink, while any soluble impurities naturally become pretty thoroughly removed.

The next process, known as ticking, consist in chopping up the softened gutta, and allowing it to fall into hot water; this operation, together with agitation in hot water, being repeated until the material is rendered fairly free from foreign matter. The ticker is represented by the diagram now on the screen (Fig. 33), and consists of a

Fig. 33.



The Ticker.

hopper, shown on the left-hand side of the diagram, and a pair of fluted rolls, which lead the soft gutta towards a rapid rotating wheel, which latter has a series of blades or cutters attached to its circumference, and these chop off the gutta in flakes, which fall into hot water. On the table are samples of gutta in its various stages of preparation, these having been kindly lent by the Gutta-percha Company. The material having been ticked and washed sufficiently, can be rolled into sheets at once, but it is usual to both masticate and strain the material when the highest degree of uniformity in texture, together with freedom from foreign matters, is desired.

The masticator employed (Fig. 34, p. 808) is similar in principle to that used in treating rubber; but its design is lighter, as the work it has to perform is comparatively easy, and Pfleiderer's kneading machines (Figs. 11, 12, 13, 14, p. 767) have been found very well suited for the mastication of gutta-percha. arrangement employed for straining the gutta-percha consists of an iron cylinder, in the lower portion of which are placed strainers of iron wire netting or gauze. The cylinder having been heated by means of steam, and filled with the soft gutta, a tightly fitting piston is forced into the upper part by means of hydraulic power, and the gutta is naturally forced out through the wire gauze. A second mastication, after the straining, is sometimes considered advisable.

Very many materials, such as lac, pitch, plaster, magnesia, clay, and other earthy substances, are occasionally incorporated with gutta-percha, in order either to harden it, cheapen the material, or to adapt it to special uses; and elastic glue, compounded of gutta-percha, resin, and pitch, forms a very useful cement in some cases.

Mixtures of india-rubber and gutta-percha are useful in many instances, and a vulcanite, having as its base equal proportions of rubber and gutta, possesses some very excellent qualities as a material for making buttons and other small articles.

As a moulding material, gutta-percha stands pre-eminent. A copper printing plate can be moulded so perfectly in the material, that an electrotype made on the gutta-percha mould yields prints indistinguishable from those taken from the original plate. Again, photographic reliefs may be most perfectly moulded in gutta; and dentists largely make use of it for obtaining casts of the interior of the mouth.

When a strip of gutta-percha is stretched, by a sufficient force, to about double its length, it is found to have acquired a fibrous texture, and to be capable of resisting a much greater strain than that which served to extend it. This can, as you see, be very well illustrated by stretching one-half of this strip.

The use of gutta in covering electrical wires and cables is probably its most important application to the requirements of modern civilisation, and numerous specimens, lent by the Silvertown Company, Messrs. Rickards, of Derby, and others, illustrate these uses. It will, doubtless, interest you to see some illustration of the method employed in covering wires with gutta-percha. Here is a small metal cylinder (Fig. 35, p. 808), which is now full of soft gutta-percha, and a solid metal plunger or piston fits into the cylinder with tolerable accuracy. In the front (on the left hand side of the diagram) there projects a short tube, the internal diameter of which serves to guage the external size of the coating on the wire; while opposite it a tube of much smaller diameter passes right through the cylinder and mouths, near the inner extremity of the first-mentioned tube. A piece of wire being now slowly drawn through the apparatus (in the case of the diagram from right to left), the plunger is forced down by means of a small press; a tube-like coating of gutta is thus, as you see, forced out around the wire. In the industrial production of the beautifully coated wires you see before you, very complex and finely adjusted machinery is made use of, but the general principle is the same as you have seen illustrated.

Photographic baths, dishes, cisterns, and other similar articles, can be readily made out of sheet gutta-percha; the edges to be united being softened by a gentle heat, but these articles are generally not equal to similar vessels of ebonite. Gutta-percha, however, has the advantage of being very easily workable.

Sound conductors, or speaking tubes, made of gutta-percha tubing, are singularly effectual, and are largely used in warehouses, and other places.

Rolled or calendered sheets of gutta-percha are

largely employed—the thick sheets being used for soling boots and such-like purposes, while the extremely thin rolled sheet, which rivals paper in tenuity, finds many uses. As a coating for damp walls it is most effectual, while as a waterproof material for certain surgical purposes it is unrivalled; and for covering over joins in telegraph wires it receives extensive application. No doubt most of you have seen telegraph workmen operate with this material in the streets of London; wrapping it round and round the joint, and at the same time softening it by means of a lamp. The large pieces of thin sheet hanging up have been lent by the Gutta-percha Company, and there are also some interesting specimens, for which I am indebted to Mr. Walter Hancock. Please notice the difference between the thin sheet made from gutta-percha which has been masticated and strained, and that which has not been masticated. The masticated sheet shows no texture; while that which has been strained but not masticated is paler in colour, and shows a kind of grain or texture, which causes it to split more readily in a longitudinal than in transverse direction. Some of these samples, lent by Mr. Hancock, are of interest, as being no less than twenty years old, a great age for gutta-percha thin sheet.

Gutta-percha tubes are manufactured by the squirting process, already referred to several times; and they are of considerable use for making syphons, or conducting tubes intended to convey corrosive liquids. Pump buckets of gutta-percha are largely made use of in mines, and are generally found to be much more durable and economical than leather buckets; while pumps made entirely of gutta-percha are occasionally made use of in chemical factories. Belting of gutta-percha answers extremely well in many cases; but it is sufficiently obvious that the use of this kind of belting is only to be recommended in cases where the temperature of the place is not likely to rise very high.

Funnels, bottles for hydrofluoric acid, jugs, boot-soles, various surgical appliances, and fancy articles are also made of gutta-percha, and there are on the table some really fine works of art executed in this material, and lent by the Gutta-percha Company. Articles of gutta-percha may be varnished by an oil varnish, that is to say, by means of a resin, or resinous gum, dissolved in boiled linseed oil, the varnish being diluted with oil of turpentine as required.

Gutta-percha does not appear to be so absolutely impervious to water, as is sometimes believed, as thin leaves or sheets of it left in water for a long time absorb sufficient to cause them to sink. The specific gravity of gutta, under ordinary circumstances, is about ·979, but the above-mentioned circumstance tends to prove that the material, if perfectly free from porosity, would possess a higher specific gravity than water.

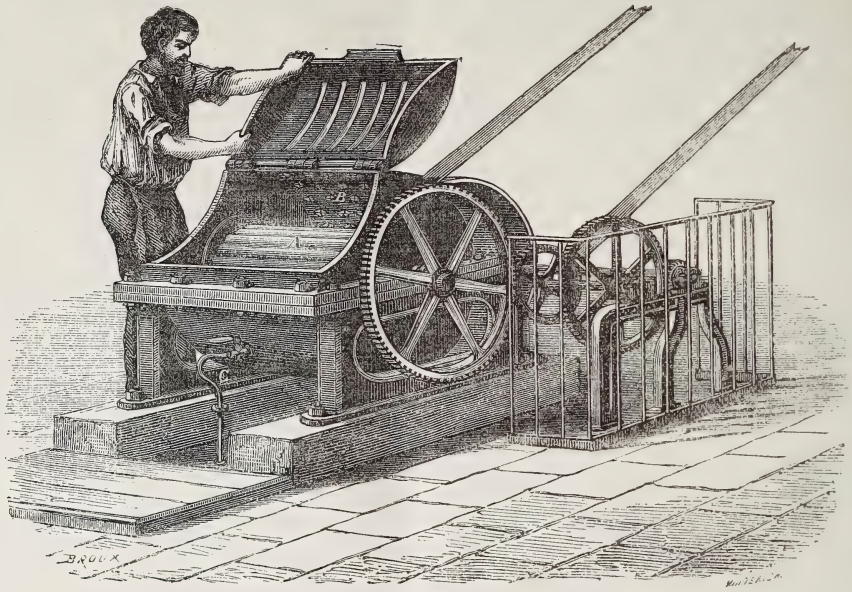
The vulcanisation of gutta-percha is, in all respects, analogous to that of india-rubber; and its primary effect is to lessen the influence of an elevated temperature on the material. As in the case of caoutchouc, vulcanisation may be effected by free sulphur, by sulphides in conjunction with free sulphur, or by certain agents which contain no free sulphur, as hypo-sulphite of lead and chloride of sulphur.

Parkes's cold curing process, in which chloride of sulphur is made use of as a vulcanising agent, can be applied in many ways to the vulcanisation of gutta-percha. Here, for example, is a piece of thin sheet, which is being exposed under a bell jar to the fumes of proto-chloride of sulphur; it is already nearly cured. As regards the dipping process, certain precautions must be observed, as a mixture of carbon disulphide and chloride of sulphur rapidly dissolves gutta percha. Perhaps the following is the best way of proceeding:—The articles to be vulcanised are dipped for an instant in a mixture of one part of chloride of sulphur with twenty parts of carbon disulphide, no time being allowed for solution to take place. The dipped article having been allowed to remain for some hours exposed to the air, reacts with the small proportion of chloride of sulphur taken up from the bath, and its surface becomes partially vulcanised and insoluble. A second dip may now be given, but this time the liquid can be allowed to act during a longer period, the surface of the article being less soluble than was the case before. As the vulcanisation proceeds, the articles may be allowed to remain longer and longer in the bath; and the result is that the gutta is vulcanised all through. Vulcanised gutta-percha is, with few exceptions, hard, and indifferent alike to the action of solvents, or of a temperature as high as 100° Centigrade. Another way of curing gutta-percha by the method in question will next be illustrated to you. Here is a solution containing four parts of gutta-percha dissolved in twenty parts of carbon disulphide; and here, on the other hand, is a mixture of one part of protochloride of sulphur with eight parts of carbon disulphide. Having now mixed these two solutions, I will pour one half of the mixed liquid into a stopped bottle, and the other half on a levelled glass plate. In about ten minutes the liquid in the bottle will have set to a jelly, owing to the fact of the gutta having become vulcanised and insoluble, while that poured on the levelled glass will form a film or skin of completely vulcanised gutta-percha, which almost resembles ivory in appearance. Some specimens vulcanised in this manner are now on the table.

When gutta-percha is cured or vulcanised by the admixture of sulphur and subsequent heating, the most serious source of failure met with is porosity of the material, this being probably due to two causes. In the first place, traces of moisture may be present; and, in the second, there appears to be some vapour evolved during the earlier stages of the curing.

Traces of water, or of mischief-working essential oil, may be often driven off, by heating the gutta to 150° for some time before incorporating the sulphur; or the volatile products formed during the earlier stages of vulcanisation may be got rid of by heating the gutta to 135° with 2 per cent. of sulphur for an hour, and then mixing the very partially cured material with 6 to 10 per cent. of sulphur, making up the required articles, and curing as in the case of rubber. Very hard vulcanised gutta may be made by incorporating a large proportion of sulphur, say 30 to 50 per cent., and curing, as for ebonite. Colouring matters may be incorporated, but the production of light tints is not so practicable as in the case of vulcanite from rubber.

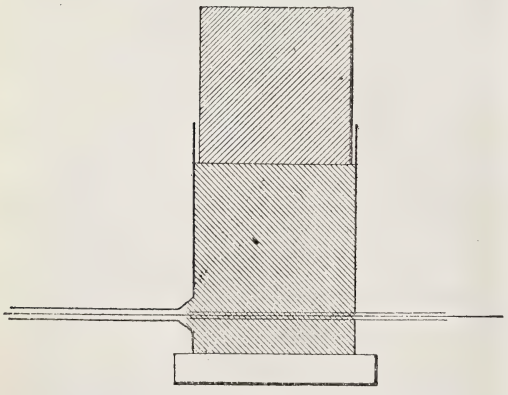
FIG. 34.



THE MASTICATOR FOR TREATING GUTTA-PERCHA.

Hancock's method of vulcanising with a mixture of sulphide of antimony and sulphur yields an excellent result with gutta-percha; six parts of the sulphide, one of sulphur, and 48 of gutta being

FIG. 35.



APPARATUS TO ILLUSTRATE THE COVERING OF WIRES WITH GUTTA-PERCHA.

good proportions. The curing requires a temperature of 135° to 140° Centigrade.

You see before you some very interesting specimens of vulcanised gutta-percha, for which I am indebted to Mr. Walter Hancock; you will notice how perfect and sharp the detail on this medal is; it being difficult to imagine the original device better defined than this is.

It now remains for me to thank you for your attention during this course; and my best thanks are due to the numerous gentlemen who have co-operated with me in my work, not only by lending me the products of their factories, but also in allowing me to visit their workshops whenever I had occasion to do so.

Your thanks and my own are also due to Mr. Barker, who has so ably helped me in the task of demonstrating many points of interest, which, without his aid, would have been impracticable.

Information conveyed through the medium of a short course of lectures is necessarily very partial and fragmentary. The things which have been omitted are naturally more numerous than those which have been said.

MISCELLANEOUS.

HORSE BREEDING IN HUNGARY.

Great attention is being paid, Consul Gosling states, to the production and breeding of horses in Hungary. The Government maintains, at its own expense, two kinds of establishments for the purpose of raising the standard of Hungarian horses, studs and stallion depôts, the studs forming part of the vast estates of the Crown, and managed by persons holding military rank. These officers are, however, under the orders of the Minister of Commerce and Agriculture, through the medium of a General attached to his department, and a council composed of members of the Civil Service. The total number of horses kept in these studs is about 4,200 at the present moment, which are distributed as follows:— At Kisber there are 430 English thoroughbreds and half-breds. The thoroughbred stock consists of seven sires and twenty-five dams. Amongst the former may

be mentioned Buccaneer, Cambuscan, Ostregar, and Bois-Roussell. Of the latter, Mineral, Beeswing, Gratitude, Deception, Firefly, Honeybee, Imperatrice, &c. The yearlings are sold by auction to persons living in the country, and they have to remain in Hungary after having finished their racing career. During the last 10 years. 220 yearlings have been sold at Kisber, and 254 half-bred stallions distributed amongst the different depôts. The stud at Babolua was founded in 1789, for the purpose of introducing the Oriental blood in Hungary. Since that time, 76 original Arab stallions and several mares have been bought in the Levant, the offspring of which, partly crossed with horses of the Hungarian breed, constitute the present total number of 450 horses. Only a limited number of 15 dams is reserved, however, for keeping up the pure Arabian breed, as it has been found that the substance of it was greatly improved by judicious crossing with the Hungarian horse, and these half-breds are therefore chiefly employed now for breeding purposes in the country. In the last 10 years, 312 sires of this kind were bred. The largest of the Government studs is at Mezöhegyes, with 1,400 horses. It is also the oldest of them, having been founded in 1785. It is only within the last 20 or 30 years that any systematic method of breeding has been followed in this last-named stud. Up to that time the most different races were brought together, with the sole object of producing horses especially fit for military service. During the different wars of Austria, at the end of the last and the beginning of the present century, many horses fell as a booty to her armies, the best specimens of which were successively tried at Mezöhegyes; thus Arab, Spanish, Holstein, Moldavian, Polish, Mecklenburg, Norman, and other bloods are all represented there. Out of these different races, five distinct breeds have been derived, and are kept up at the present time, viz.: —(1) The Gidrans, by Gidran, an original Arab stallion, brought into the country in 1818. By crossing this breed with English blood it has greatly gained in substance and bone. The average height of these horses is 168 centimetres. (2 and 3) The Noniuses, by Nonius, a Norman stallion, captured in 1815 at Rosières, in France. He was put to the strongest mares, and constant in-and-in breeding kept up until recently, when, but only for a short time, their breed was crossed with some English thoroughbreds. The height of these two families, kept separate from the beginning, is 160 and 173 centimeters respectively. They make excellent carriage and cart horses; not perfect in all points, as far as their shape is concerned, but of first-rate quality. (4) The English half-bred horses, by Furioso and North Star, less pure in origin than those of Kisber, but of a quite distinct character. (5) The Norfolk cart horses, out of the heaviest mares of the stud, by original Norfolk sires, lately acquired in the more peaceful way of purchase in England. Altogether, in the last ten years, 1,400 sires have come from Mezöhegyes for breeding purposes.

The stud at Togaras was founded in 1874, with the special object of improving the breed of those rather insignificant looking, but exceedingly hardy ponies, which are to be met with in the mountains and rocky countries of the North of Hungary. The stock of horses in this stud is of a mixed Neapolitan, Spanish, and Oriental origin, which has been moulded in the course of more than 200 years into a special breed, in the Imperial stud of Lysicza, near Trieste. The average height of these horses is 154 centimeters, and rarely exceeds 157 centimeters. The stallion depôts, mentioned above, are establishments kept by the Government in different places where the mares of the peasants and other private persons are taken to the stallions which have bred in the studs or purchased abroad. The charges are very low, varying from 2s. and 8s. to 25s. for sires of the best breeds. Besides larger establishments of this kind in the principal towns, with 100,550 stallions, horses are sent to 600 communities yearly for breeding purposes, or let on hire under certain conditions to private studs.

There are at the present moment about 1,800 stallions belonging to the Government at the disposal of private breeders, amongst them 73 English thoroughbreds, 45 Arab thoroughbreds, 550 English half-breds, 450 Arab half-breds, 220 Norman, 50 Norfolk stallions, 130 sires of the "Lysicza" breed, and others. In the distribution of these stallions all over the country, special regard is paid for the sake of rational breeding to the kind of horses most prevalent in every particular district. The Government is anxious besides to instruct the population in the true principles of crossing and breeding, through their agents, and by popular pamphlets distributed in great numbers and free of charge. So much care has been given to this branch of agricultural production, which is otherwise also deeply rooted in the national life of the Hungarians, that it is hardly to be wondered at if the quality and appearance of the Hungarian horse improves visibly from year to year.

CINCHONA CULTIVATION IN BENGAL.

The report of the Government Cinchona Plantation in British Sikkim for the year 1879-80 has been received, from which it appears that the season was unusually favourable for planting operations, and about three-quarters of a million of young trees were planted out, of which 644,222 were *Succirubra*, covering an area of a little above 196 acres, against 353,415 planted over an area of 120 acres in the previous year. During the year, 276,700 trees of this species were put out on the new plantation of Sittong, covering an area of nearly 101 acres; 258,620 were planted on the old plantation of Rishap and Mungpoo, though on virgin soil, and 108,900 replaced those that had to be uprooted for the bark crop. In addition to these, a good many young plants were utilised in filling up gaps as they occurred in the older parts of the plantation.

In the resolution recorded upon the proceedings of last year, it was stated that the Lieutenant-Governor, in view of the more extensive cultivation of *Cinchona calisaya*, had authorised Dr. King to proceed to Java and ascertain the condition under which the Dutch have successfully grown that variety of cinchona. Dr. King accordingly visited the plantations in Java during the year. The result of his visit to that island was embodied by him in an interesting report received by Government, on the 22nd November last, and forwarded to the Government of India on the 15th December, 1879. The report shows that, in respect of soil and climate, the Java plantations have great advantages over those of Sikkim, but on the other hand labour is much cheaper in British Sikkim. The conclusions arrived at by Dr. King were that efforts should be made to graft *Ledgeriana* and approved varieties of *Calisaya* on *Succirubra* stocks, that attention should be directed towards propagating the best varieties of *Calisaya*; that trial should be given to the Java plan of shaving the bark of cinchona trees; and that a more suitable locality for cinchona cultivation than Sikkim should be sought for in Burma, the Andaman Islands, and the Khasi Hills. The Dutch method of shaving the bark of living trees has already been tried at Mungpoo, but there has been as yet no time to judge of the results.

The entire produce of the plantations for the year was 361,590 lbs. of dry bark, against 261,659 lbs. in 1878-79; of this, 29,520 lbs. were yellow, and the rest red bark. The new plantation of Sittong grew its first crop during the year, and of the bark gathered, 15,850 lbs. represented the yield of that plantation. The aggregate yield of bark in former years amounted to 1,134,901 lbs., so that the total produce of the plantations since their opening, including the crop of the past year, has been 1,496,491 lbs.

The total expenditure on the plantation amounted to Rs.69,973 0 4, of which Rs.15,204 4 6 represented the capital expenditure on the new plantation at Sittong, and Rs.54,768 11 10 the working expenses of the old plantations.

The Superintendent reports that there is a considerable demand for seed of *Cinchona succirubra* among the coffee-planters of Ceylon, who sow it broadcast between the trees on their plantation, as also for seed of *Cinchona calisaya*; but it has been found impossible to meet the demand for the seed of the latter variety to the full extent, as the bulk is required for the Government plantation.

The total out-turn of the febrifuge factory for the year just passed was 9,434 lb. 13 oz., against 7,007 lb. in the previous year. The demand of that year, however, amounted to 7,955 lb. 7 oz., which Mr. Wood, the quinologist, was able to meet from the large stock that he had on hand at the commencement of the year. The febrifuge factory has been extended during the year, and is now on a sufficiently large scale to meet all probable current demands, and at the same time to maintain a sufficient reserve stock of the alkaloid as now manufactured.

The total expenditure on the plantation from its commencement (including compound interest at 4 per cent.) is a little less than 10 lakhs of rupees. The cash transactions for the year therefore show a profit of rather more than 5½ per cent. on the capital. But this does not represent the whole of the gain for the year, for the stock in hand has been increased in value by Rs. 42,775, which is equal to another 4 per cent. on the capital. The amount of febrifuge used in substitution of quinine in Government hospitals and dispensaries during the past year was 5,400 lbs. Calculating the average price of quinine in Calcutta at 90 rupees (a rather low estimate), the saving effected by this substitution during the year has been very nearly four lakhs of rupees, and the total saving since the factory commenced working aggregates 11⅓ lakhs of rupees, or more than the plantations have cost since their opening.

The Lieutenant-Governor regrets the loss of the valuable services of Mr. Wood, who resigned his appointment of quinologist during the year. The thanks of Government are also given to Dr. King, whose management of his department leaves nothing to be desired.

ADMISSION TO PUBLIC INSTITUTIONS.

The objects sought for by the Committee on Public Museums and their Educational Uses, which was appointed many years ago by the Society of Arts, are now likely to be attained to some extent by the further facilities about to be granted at two public institutions, the National Gallery and the Tower of London. At the National Gallery the public are to be admitted on students' days by a small payment, not to make a revenue, but to keep the gallery quiet for students. This arrangement has been tried at the South Kensington Museum with entire success. It has never been closed to the public on week days, since the year 1856, when the Museum was first opened. Lord Frederick Cavendish made the announcement in the House of Commons, on the 26th August.

Two evenings before, Mr. Childers, the Secretary of State for War, made the following statement respecting the Tower of London, in answer to the questions of the two hon. members for the Tower Hamlets (Mr. Bryce and Mr. Ritchie):—"Very soon after I became Secretary of State, my attention was called to the numerous complaints made as to the arrangements for the admission of visitors to the Tower, and I at once instituted inquiries on the subject. I have visited the Tower myself as one of the public, unknown to the officials, and am thus personally aware of the objections to the present arrangements. The Tower is at once a palace, a prison, a fortress, an ordnance store, a museum of antiquities, and a jewel-house; and in any arrangements for the better convenience of visitors several departments have had to be consulted. I am glad to be able now to state to the House that her Majesty has been graciously pleased to approve arrangements being made as an experiment, under which the conditions of admission will be assimilated to those of other places of interest in the metropolis; the system of batches of visitors being personally conducted round by warders will be given up, and care will be taken to describe the objects of interest in an improved catalogue, and by attached labels. A committee has been appointed to work out the details of the new plan, which will be brought into operation as soon as possible, but I fear not before the close of the Session. The possibility of showing to visitors additional places of interest will be considered by the committee, and also the question of an additional free day, but the latter is one of expense, affecting the estimates."

TREATMENT OF THE CAMEL.

Some practical notes on the camel, by Captain A. G Yaldwyn, have appeared in the *Journal of the United Service Institution of India*, from which the following particulars were taken. The Arabian camel with one hump is found in Afghanistan, Scind, the Punjab, Bikaneer, and Oudh. The Bactrian, or mountain camel, distinguished by two humps, is to be seen in India. The feeding of camels requires as much care and supervision as is bestowed on cavalry or artillery horses. On the march the animals should be given their rations all at once, when their day's work is over. The watering of camels is of equal importance to their feeding, and is not generally understood. The Arabian species can take in five or six gallons of water, which is sufficient for their use for about six days. The Bactrian species can only take in about half the above quantity. To ensure the supply, camel men travelling with their own camels pour water out of ghurrahs down their camels' throats, which the camels understand by instinct to be a necessary precaution, and they take in the water willingly. It is misleading to say that a camel can go without water longer than any other animal, for he requires drink daily like other beasts, if a supply has not previously been administered. The load of the camel has been fixed at 5 maunds (125 lbs.), but their carrying power must necessarily vary with their condition. Some are not fit to carry 4 maunds, whilst others will carry 8 maunds without overstraining their powers. A camel's carrying power is equal to that of two and a half mules or ponies, whilst his ration is only about that of one mule or pony, taking grain and fodder together into account. Thus 500 camels only eat as much as 500 mules or ponies, and whilst the latter can only carry 1,000 maunds, the former can carry [2,500 maunds. Again, 500 camels only require 125 attendants to be paid, clothed, and fed, whilst 500 mules or ponies require 167 attendants. Camels are bad climbers, owing to their weakness behind. They are good goers in loose sandy soil, and even over stony ground, if the stones are not too large or sharp. In slippery ground they are almost useless, as they have no hold with their feet. They are very enduring when well cared for, and can go the longest marches day after day, at an average speed of at least two miles an hour. They are good at fording rivers which are deep but not rapid, and where the bottom of the ford is shifting sand, the passage of a number of camels over it renders it hard and firm. The weight of a full grown camel may be taken at 10 cwt., or 14 maunds; this knowledge may prove useful where there are weak bridges. The average height of a full grown camel is seven feet to the top of the hump, and his average length from nose to tail is eight feet. A string of 500 camels covers about one mile of road. Whilst 500 camels carrying 2,500 maunds covers only one mile of road, 1,250 mules or ponies, carrying 2,500

maunds, would cover about two miles of road. The camel is subject to several diseases, and Captain Yaldwyn describes the remedy for each.

BRUSSELS VETERINARY CONGRESS.

At this Congress, held in connection with the Brussels Exhibition, the first question discussed was the inspection of food substances of animals and the possibility of communicating various maladies to the human subject, through the use of diseased meat or infected milk. After an interesting discussion, the report of M. Van Hertsen was adopted, of which the following are the principal conclusions:—

Considering that foreign meat may exert a very injurious influence on the health, the Congress insists upon the advisability of establishing international offices for the inspection of imports.

The inspection of meat for consumption should be rigorously enforced, and no meat be sold that is not stamped and accompanied by a certificate from the veterinary officer.

Considering the great increase of late years, in the consumption of pork prepared in various ways, chiefly due to the imports from America, and new methods of preparation, the Congress thinks it indispensable that all places for sale, preparation, and storage be regularly inspected.

Special precautions should be taken by the Government for preventing the products of the knacker's yard from being sold as food.

The consumption of milk in its natural state may be highly dangerous, inasmuch as it is capable of transmitting various maladies to the human subject; and the inspection, as now practised, for ensuring the freedom from morbid alteration or adulteration of milk is notoriously insufficient.

The Congress also passed the following resolutions:—(1.) That a permanent and sanitary committee be appointed on the Berlin model; (2.) That properly organised laboratories be erected and maintained for the analysis of all suspected articles of food, especially milk; and (3.) That district offices be provided for testing the quality of milk as retailed.

PAPER-MAKING INDUSTRIES IN CHINA.

The Commissioner of Customs at Wuhu (China), in a report recently issued, states that paper is very extensively manufactured in the numerous little villages situated in the valleys among the hills, about eight miles to the south-east of the city of King-hien. It is made from the bark called T'an-shu-p'i, the paper-mulberry tree bark, and wheat straw, which, after having been well washed and boiled with a certain proportion of lime, is again washed, and then exposed to dry for a whole year on the sides of the hills, in spots where the grass and brushwood have been previously cleared away for this purpose. After the year's exposure, it is washed once more, and then pounded on a stone with a large wooden hammer; it is supposed to require 1,400 blows from this hammer to reduce it to the necessary consistency; after which it is removed to another building, and left to soak until it becomes quite a pulp, in a large earthenware vessel, containing a liquid glue, made from boiling the branch of a tree called the Yangkowt'êng, a species of hooked vine. This pulp is then put into a cistern of water, and well stirred up with a stout stick. A finely made bamboo frame, or sort of long oblong sieve, is taken by two men, one at either end, and dipped twice into this liquid, which is made to run equally over the whole surface, somewhat after the manner in which the photographer allows the developing solution to run over his plate. By this means, a thin and tolerably even layer is left, which soon partially dries and forms the sheet of paper, and which is removed by simply reversing the frame. As soon as a sufficient number of sheets has been made, they are taken to the drying-room. This room contains a large brick oven, coated on the outside with lime, and built up to within a few feet of the roof. Upon the top of this oven the paper is placed, in parcels of about a foot in thickness, until perfectly dry; after which, sheet by sheet is damped once more, and while still moist, is by means of a soft brush, made to adhere to the sides of the oven for a short time, to undergo its final process of drying. It is then taken away to the packing-room, and made up into bales, weighing from 80 to 120 catties each, the catty being equivalent to $1\frac{1}{3}$ lbs. avoirdupois. The largest sized paper is about 1 "chang" ($11\frac{3}{4}$ feet) long, and is worth one dollar a sheet. This particular size of paper is made entirely from the "T'an-shu-p'i," but the smaller sizes are composed of a mixture of the above-mentioned bark, or the bark of the paper-mulberry tree and wheat straw. This paper is known by the name "Suan-chih," and is considered a good quality paper in the Chinese markets.

CORRESPONDENCE.

LIQUID FUEL FOR STEAMERS.

Regarding the use of petroleum—or rather the refuse of petroleum—as fuel, on board the *Cesarewitch*, Russian mail steamer, on the Caspian Sea, a notice of which appears in *Journal* of July 30th, it may be interesting to some of your readers to know, that in 1868, a small yacht was steaming about the Solent, on board which liquid fuel, in the shape of common creosote, was the only fuel used, She was the property of a small private company, organised under the Limited Liability Act, for developing a method of utilising mineral oils as steam fuel, under a patent taken out in the joint names of the late Mr. Sim and myself. Previous to my taking her round to Southampton, the yacht had been some two or three months in Woolwich Dockyard, where the Sim and Barff method was thoroughly tested by the officials connected with the steam department, and a report made to the Admiralty, the substance of which, however, I was never made acquainted with; but I have reason to suppose that it was a tolerably satisfactory one, as some time afterwards I had a communication from the chief engineer, informing me that his estimates for certain experiments with our method, which I had suggested, should be made in the boilers of H.M. gun-boat *Teazer*, had been approved and passed. Meanwhile, accident had discovered a simpler method than that of Sim and Barff. During the trials, when in the dockyard, the apparatus had not worked quite so well as we could have wished. The yacht was made fast to the wharf, and the engines kept going continuously, but we had barely been able to keep them up to full speed. The boiler was of a novel construction, by Amos and Anderson, after a design of my own. The late Admiral McKillop, who kindly assisted me, was of opinion that it was the fault of the boiler, and we had some idea of putting in another one. On leaving Woolwich, we were only able to generate sufficient steam to maintain about half-speed. After proceeding some two or three miles, all at once the boiler commenced to generate steam, not only sufficient to maintain full speed, but to blow off at the safety valve, regulated to 60 lbs. pressure, at a rate which might almost be called alarming. The next day, when all was cooled down, and we were able to investigate the cause of the great improvement, it was discovered that a large, and what we thought an important, portion of the apparatus had been melted, leaving only the jet of steam and oil spray, such as that described in your *Journal* as being used on board the *Cesarewitch*, subsequently this was found to be, if not quite so economical, the most practical method. On considera-

tion, the directors deemed this fatal to the Sim and Barff patent. Nor were they able to see their way to taking out a new one, which, they were advised, had a fair prospect of being maintained. Much to my regret, the efforts and resources of the company were devoted to develop a method of carburetting coal-gas by means of hydro-carbons.

After keeping the yacht a short time at Rochester—during which she was inspected by Mr. Allen, of the P. and O. Company—I took her to Southampton. During part of the time, I lent her to the late Commodore Goodenough, then in command of the *Minotaur*, flagship to the Channel squadron. I have a letter written by him, in which he expresses a high opinion of the method; also his conviction that eventually liquid fuel would be that of the Navy.

By a log that was kept, I find that, during the time we were using this fuel, we steamed upwards of two thousand miles without a single hitch of any sort.

My experience of liquid fuel enables me to fully endorse what is said in the notice in your *Journal* concerning what is done on board the *Cesarewitch*, viz., "That it has the advantage of requiring no stoking, as no ashes are produced; that, by turning down the flame to the required degree, steam can be kept at the pressure necessary for immediate starting, without the tedious and more wasteful process of 'banking;' and that such a method is 'invaluable to cruisers.' Further, that it is—when the steam and oil are properly regulated—entirely smokeless; that its cost does not exceed that of coal, and is more economical of space; that there is less fear of explosion or spontaneous combustion, as whatever gas might be generated in the tanks would be on the surface, and could easily be allowed to escape into the open air." When I saw that such a man as Admiral Selwyn had taken up the subject, I made sure that the adoption of liquid fuel into the Navy would have taken place long before this. The difficulties made by the Marine Insurance Companies—the vague fears of anything under the name of mineral oil on the part of marine engineers—are much against its first introduction by the mercantile navy.

Probably, the simplicity of the best method, and the number of patents relating to liquid fuels which have lapsed, rendering it difficult to take one out which could be maintained, together with the expense which must attend its first introduction, may account for the apparent neglect of so important a subject. I am convinced it is not on account of the impractibility of using liquid fuel, for it has long been in use at the creosoting works of Messrs. Burt, Bolton, and Heywood, the large timber merchants, as well as in many places in the United States.

Arthur Barff.

Merton-cottage, Merton, Surrey,
August 10th, 1880.

STEERING AND CHECKING GEAR.

I thank the Society very much for permitting me to place my model of steering and checking gear in their reading-room, and am grateful for the opportunity afforded me to show the public that, at least, one individual has not been idle to overcome one of the great puzzles of the age, namely, how to construct a good water break. I have been at this subject three years. My model has this recommendation for, at least, inspection, that if the system upon which it is constructed is adopted, namely, meeting the resistance of the water at the lowest angle of opposition, and gradually increasing the angle as the momentum of the floating body is checked, steam launches will be rendered perfectly manageable, and, therefore, harmless, and the British captain or admiral may not be at the risk of losing his sword by decree of court martial (even for a month or two), just because his wayward old ironclad won't steer or pull up from any inducement he has to offer her.

August 30, 1880. J. B. Heathorn.

GENERAL NOTES.

Savings in Postage Stamps.—The Postmaster-General, in his speech on Tuesday, 24th ult., on the Savings Bank Bill, informed the House of Commons that an experiment is about to be tried under his direction, for affording facilities to the public for collecting, by means of postage stamps, sums of one shilling, that being the smallest amount now received by the Post-office Savings Bank. The following is a note appended to the form issued by the Department:—"Any person desirous of saving 1s., by means of penny contributions, for deposit in the Post-office Savings Bank, may do so by purchasing with every penny so saved a penny postage stamp and affixing it to this form. When 12 such stamps have been so affixed, the form may then be taken to any post-office savings bank in the United Kingdom, where it will be received by the postmaster, either as the first deposit in a new account then to be opened, or as an ordinary deposit if the owner of it has already opened an account. The stamps affixed to this form must not be defaced or in any way damaged, or they cannot be received by a postmaster." The experiment will only be tried partially in the first instance.

The Woollen Industry.—There are few things more remarkable than the growth of the woollen industry of the world during the present century; and this growth, which has been most marked since 1830, is mainly due to the extension of our own colonies and the development of the United States. The wool clip of the world has increased by five times since 1830, when it was equal to about 320,000,000 lbs., while in 1878—the latest year we have complete figures for—it amounted to nearly 1,600,000,000 lbs., which, when scoured, gives 850,000,000 lbs. of clean wool. Previous to 1830, nearly all the world's supply of wool was furnished by Europe; 280,000,000 lbs., out of the entire world's supply of 320,000,000 lbs., being European:—

	1830.	1878.
European produce... ...	280,000,000 lbs. ...	740,000,000 lbs.
River Plate	22,000,000 lbs. ...	240,000,000 lbs.
United States	10,000,000 lbs. ...	208,000,000 lbs.
Australia	6,000,000 lbs. ...	350,000,000 lbs.
South Africa	2,000,000 lbs. ...	48,000,000 lbs.
	320,000,000 lbs. ...	1,586,000,000 lbs.

The tendency is to increase and improve the production of wool by improving breeds, by careful management, by improvements and cleansing the wool of the sheep before clipping, as well as by improved machinery for washing and scouring fleeces after having been clipped and sorted. It would be interesting to show the total number of persons engaged in the woollen industry of the world, as far as operatives are concerned. We have a fair idea of the numbers; although the manufacturers of wool and cotton fabrics represent an almost equal amount in value, the number of operatives in woollen mills is only two-thirds of that engaged in cotton mills:—

	Operatives.	Spindles.	Consumption.
Great Britain...	... 280,000 ...	5,100.000 ...	380,000.000 lbs.
France ...	... 170,000 ...	2,500,000 ...	380,000,000 lbs.
Germany ...	... 120,000 ...	1,800,000 ...	165,000,000 lbs.
United States...	... 120.000 ...	1,400,000 ...	250,000,000 lbs.
Russia, Austria, &c....	223,000 ...	1,800,000 ...	400,000,000 lbs.
	913,000	12,600,000	1,575,000,000 lbs.

Although France and Great Britain consume the same quantity of wool, in France it is to a greater extent the unscoured wool of the River Plate, which only turns out 30 per cent. of wool, whereas, in England, it is native or washed Australian which is mainly used; hence the woollen manufactories in Great Britain are considerably greater than in France, although the pounds weight consumed would appear to be the same..—*Wool.*

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,451. VOL. XXVIII.

FRIDAY, SEPTEMBER 10, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

HOUSE DRAINAGE AND SEWAGE WORK AS A SPECIALITY.

The tenour of the evidence which has been received by the Sanitary Section, and discussed at meetings of the Society, has shown that the most fatal errors in the application of settled principles of sanitary work are committed in the construction and drainage of edifices even of the first-class in the metropolis, by architects of the highest position. I believe I am warranted in stating it as the conviction of our Section, that for the public protection, the subject of house drainage must be cultivated and practised as a speciality. This conviction will, I believe, be strengthened by what takes place in the United States. There, the English practice in house drainage works and sewerage is generally closely followed by American as well as by English architects and artisans. There may be deviations from old routine, and improvements might be looked for from American artisans, where the conditions are such as to stimulate the exercise of the suggestive faculty of ingenuity; but there, as here, they do not appear yet to arise there in common practice. A report made to the Massachussetts State Board of Health, by Mr. Elliot G. Clarke, principal assistant engineer of sewerage works, in Boston, presents such a reflex of the errors in principle committed in common British practice, most of them, no doubt, carried over from England, that I have begged for the loan of the woodcut illustrations, to reprint with the report, for instruction here, and the State Board has been so kind as to lend them for the purpose.

I am glad, however, to learn that sanitary science in construction is being taken up as a speciality in the United States, and I believe, from the report of Mr. G. E. Waring, jun., of Newport, on the condition of Washington, that if the principles he propounds are taken up by the Government there, for putting its seat in a proper condition, as an example to other cities in the Union, the United States Government may set an example to our Government of what may be done even for the British metropolis. He shows, what has long been shown for London, but not done, how the damp of its surcharged site may be removed by subsoil drainage; how a system of circulation may be introduced, and one of stagnation removed. He would carry in the pure water direct by a constant supply, without cisternage and without stagnation, and would remove all the fouled water, and all the excretory matter from the houses by self-cleansing drains, and from the town by self-cleansing sewers. He would remove storm-water by separate channels to the river, and not mix it with the discharges from the house, and create a necessity for large man-sized sewers, accumulating stagnant deposit, or extended cesspools such as those under the Metropolitan Board of Works or the Vestries in London, in which the putrefactive matter is kept for weeks and months, giving off the noxious products of decomposition, and diffusing them into houses and streets. He proposes that all waste organic matter should be delivered at the mouth of the sewer at least within 24 hours of its production. I believe that it may be done at less time than that at Washington. To do this there must be a proper adaptation of the sizes of the drains and sewers to concentrate the flow of the fouled waters, and to make them self-cleansing. In exposition of the ignorance which is prevalent there as well as here, he states, for example, "that the particular idea of the size of a drain required to receive the drainage of a house or of a number of houses is strangely in error. A pipe six inches in diameter, having an inclination of four inches in 100 feet, has a capacity of discharge of nearly 200 gallons per minute, say 12,000 gallons per hour, or, between three and eleven in the morning, 30,000 gallons. It is usual to estimate that during the three hours about one-third of the daily flow is discharged. Such a pipe, then, at such an inclination, would be adequate to the removal of nearly 150,000 gallons per day. If each household averages six persons, and if the daily consumption is even 50 gallons per head, the service would suffice for 500 houses; or supposing the sewer to run only half full, for 250 houses." Here, in London, it is common to put down drain pipes of that size for single houses. "It is to be considered, also, that it is rarely necessary to lay a sewer with so slight a fall as four inches in a hundred feet, and that an increase of fall, secures, of course, an increase of discharge. During the past year, under the direction of the National Board of Health, I have made a number of gaugings in different parts of the country, to determine the actual practical dry weather flow of the public sewers during the hours of the greatest use." Our local sanitary authorities would do well to follow this example. He says the result of these gaugings fully sustain the estimate thus given. "Generally, where from 50 to 100 houses contributed to the sewer, the discharge filled a 6-inch pipe from less than one to two and one half-inch deep. A sewer in Milwaukie, draining an area of about 75 acres, and serving a population of over 3,000, had the whole of its flow through a six-inch pipe, which it did not entirely fill. A sewer in St. Louis, draining a district of over 11,000, had its entire flow through a 12-inch pipe, which it only about one half filled. The belief is very general that if a given flow of sewage can be discharged through a small pipe, it can surely be discharged through a large one. This is not true. The whole sewage, solid matters and all, will be completely removed by a small sewer, while only the liquid portions and the smaller solids will be removed by a large one. The solid matters, beyond the capacity of the broad and deep stream to move them, remain as a deposit in the large sewer, always subject to decomposition, and often liable to obstruct the water-way, to lessen the already slight scouring capacity, and to invite further deposits." In this metropolis, there are estimated to be upwards of a thousand miles of sewers of deposits—extended cesspools—chiefly under the management of the Vestries, that serve as dire demonstrations of these truths, as well as the house drains in the common conditions described in the annexed report. It will be found in the United States, that by following out the principles set forth, that three houses and three towns may be generally drained well, at the cost heretofore incurred in draining one ill. EDWIN CHADWICK.

COMMON DEFECTS IN HOUSE-DRAINS.

The purpose of this paper is to state what are the common defects in house-drains, and to show the usual forms and condition of such drains as they exist in our cities and towns to-day. The statement is chiefly based on observations made in Boston while constructing intercepting sewers; but it is assumed that examinations in other cities and towns of the Commonwealth would reveal a condition certainly no better, and probably worse. Some testimony will be offered from those whose occupation has given them opportunities for observation; and, while it is not intended to cite exceptional cases of defective

arrangement or construction, a few characteristic examples will be given, such as investigation would prove to be very common.

What are the essential conditions of an efficient house-drain, one or more of which must be violated to constitute a defect?

Briefly stated, they are, that the drain must be of size and shape to concentrate its flow, smooth inside, suitably inclined, tight, properly connected with the house-pipes and sewer, strong and durable in material. It is of great importance that the portion of the drain within the house should always be in such a position as to admit of ready inspection at any time; it should be in sight,* and not concealed. Let us see what proportion of Boston drains reasonably fulfil these conditions.

Existence is perhaps the most essential condition of a drain; and, by an Hibernicism, non-existence may be termed its most serious defect. Naturally, non-existence was not observed in digging for the intercepting sewers, but there is sufficient evidence that it is not unknown.

The writer has seen a case where a drain-pipe from a dwelling ran through the walls, and there ended. Several similar cases have been reported to him; and another, where a block of six expensive houses, occupied for months with all the customary apparatus in the way of plumbing and waste-pipes in full operation, had no drains beyond the walls to the street-sewer. Such cases are rare, and generally reveal themselves quickly; but it is more common to find drains which are so solidly filled with earth, grease, and other matter, as to exist only in name, and which, for any good they accomplish, might just as well not exist at all. One, examined by the writer some months since, had apparently had nothing through it for years, the whole waste from the

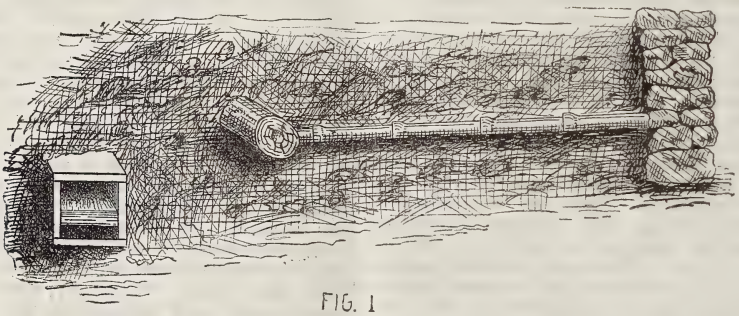


FIG. 1

soil-pipe having accumulated beneath the cellar-floor. The same state of things was found to exist below the Rockland Bank Building in Boston. A case has been mentioned to the writer where it is thought that three deaths can be directly traced to the stoppage of a drain which was so clogged as not to act. Almost every one who has been led into this line of inquiry has some similar instance to relate, and evidence could be multiplied indefinitely. Of the house-drains crossing the intercepting-sewer trench, during its construction last season, fully 25 per cent. were almost or entirely choked with sludge.

An example of semi-existence, observed while digging for the sewer in Charles-street, is worth noting, as showing the intelligent judgment sometimes exercised in doing this kind of work. It will be understood by referring to the sketch (Fig. 1). The drain was one for surface-water; and the drain-layer, in digging from the house towards the sewer, came upon a log lying across his trench, and here stopped short, chopped a hole in the log, found it hollow, and connected his drain to it without going farther. It is true, the log led to no outlet, but then it saved trouble—to the drain-layer.

As to the question of size of drains, it was found that of 113 observed while building sewers the past year—

11	were about	4	inches	in	diameter.
4	,,	,, 5	,,	,,	
21	,,	,, 6	,,	,,	
5	,,	,, 7	,,	,,	
27	,,	,, 8	,,	,,	
8	,,	,, 9	,,	,,	
11	,,	,, 10	,,	,,	
26	,,	,, 12	,, or over	,,	

The sketch below (Fig. 2) illustrates the wide range

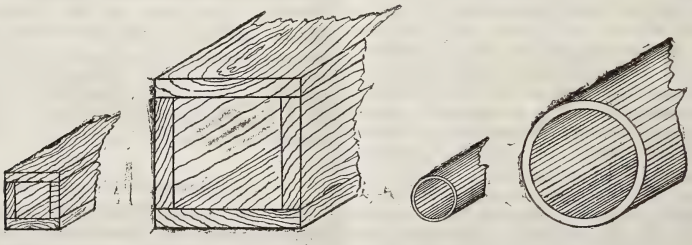


FIG. 2

of this diversity. Most of them drained single dwellings similarly situated; and if the small ones were large enough the others must have been unnecessarily large, and *vice versa*.

But what is the proper size?

Probably nine engineers out of ten would answer, "By no means larger than 6 inches;" and nine drain-layers out of ten would now say, "Never smaller than 8 inches." The former argue that the drain need only be large enough to pass through it all that it can reasonably be expected to carry, and that anything beyonds this tends to make the ordinary flow spread thinly over a wide bottom, without a suffi-

* The same rule applies, of course, to soil-pipes, although that part of the subject does not come within the scope of the present inquiry.

cient depth to carry solid matters along with it. The latter reply that, in fact, a drain never does receive only what can reasonably be expected; and that, the larger



FIG. 3

the drain, the more storage room for the unreasonable accumulation of clothing, tin and glass ware, dead animals, &c., usually found in it. "In practice," say they, "large drains take longer to choke up than small ones, and are therefore better."

Their facts are correct, but their conclusions may be doubted. In building a drain, the object should be to prevent the beginning of a deposit; and this is much easier in a small drain than in a large one, as will be understood from Fig. 3, where an equal quantity of water is supposed to be flowing in a 4-inch and a 12-inch drain. It might be thought (by one who thought at all about such matters) that the discharge of a great volume of water, as from a bath-tub, would tend to scour out and clean a drain. So it might a very small one. But in such a structure as our sketch represents, with a flat bottom 12 inches wide, the stream caused by such a discharge would probably meander over the bottom of the drain, and be nowhere over a quarter of an inch deep. Let a deposit once begin, and subsequent accretions as surely choke a large drain as a small one, only it takes longer to do it. And it may

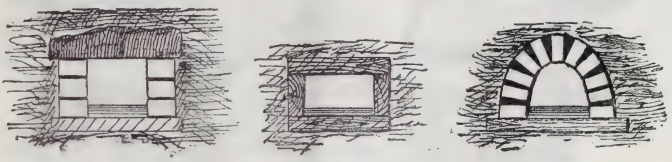


FIG. 4 FIG. 5 FIG. 6

even be questioned whether it is an advantage to be able for to use for an additional year a drain nearly full of putrescent filth, or whether it is not better to have the evil disclosed and remedied as soon as possible. It may safely be said that three-quarters at least of the house-drains in Boston are too large, because, even if some of them perform efficient services, small ones would do as well, and be less liable to get out of order.

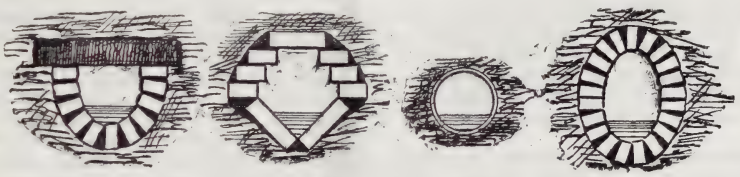


FIG. 7 FIG. 8 FIG. 9 FIG. 10

In respect to form, there is almost as much diversity as there is in size. Figs. 4 to 10 give the more common shapes.

The first three must be condemned at once, on account of their flat bottoms. The water passing through them spreads out into a thin sheet, which does not readily wash along solid matters. Floating matters also tend to stick in the angular corners more than they would



FIG. 11 FIG. 12 FIG. 13

on rounded surfaces. That this is so, is shown by the record. Of the 113 house-drains whose condition was noted, 45 were constructed with flat bottoms; and of these, 26 were choked, or nearly so, with sludge; 19 were reasonably clean. Of the remaining 68, which had rounding bottoms, 12 were full, or partly so, of sludge; 56 were reasonably clean. The common appearance of these flat-bottomed drains, as they were uncovered, is shown in Figs. 11, 12, and 13. Fig. 13 represents the condition of a drain, now disused, which came from the City Hospital grounds.

The shapes shown in Figs. 7, 8, 9, and 10 are unobjectionable, although, in fact, these drains were often too large, and had other defects. Fig. 8 is a kind of construction which was in vogue twenty-five years ago; and, except for liability to open joints, its angular bottom and its size is passably good. Our facts seem to show that 40 per cent. of the Boston house-drains are defective in shape.

A drain should be smooth, so as to afford no prominences for solid particles to lodge upon. Planed wood, slate, and brick are smooth enough. In use they soon become covered with a film of slime that makes them very slippery. Unplaned wood, which until recently

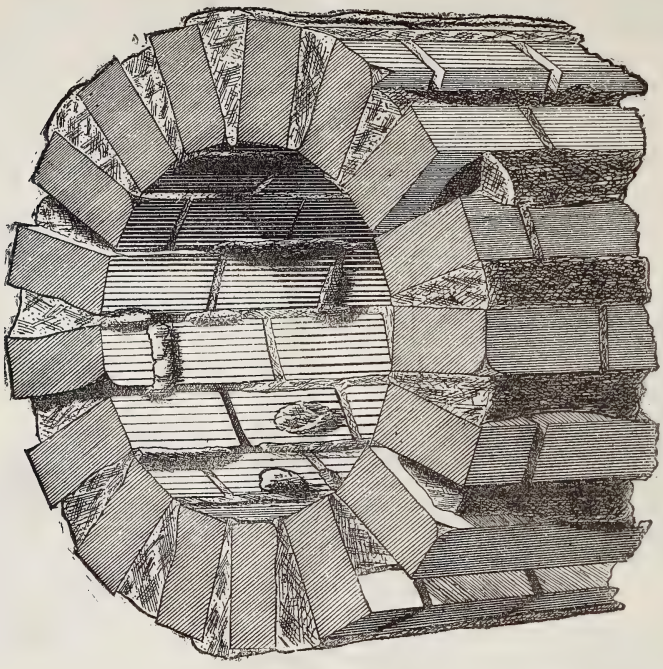


FIG. 14

has been somewhat used, is apt to be rough, and to have splinters pointing against the flow, which catch solids moving upon them. The chief difficulty in making a brick drain smooth is the care required to see that no mortar is left projecting into the drain. Fig. 14 shows the manner in which such work is often finished.

It is possible to strike each joint of the lower half of the drain so as to leave a reasonably smooth surface; but a difficulty harder to avoid is caused by portions of the mortar uniting the arch-bricks, falling when the supporting centres are removed. These lumps of cement, indicated in the sketch, adhere to the bottom, and, unless carefully scraped off, harden, and form serious obstructions to the flow of sewage.

Pipe-drains, whether cement, clay, or iron, are smoother than those of brick. Glazed clay pipes are especially smooth. In these, however, it is very common to find the mortar uniting the several sections of pipe projecting into the interior, forming a series of little dams which obstruct the flow. Fig. 15 illustrates this. This can be avoided by carefully cleaning the interior of each pipe, after laying it, with a swab or hoe; a simple precaution, but often neglected by a careless drain-layer. It will not be an exaggeration to say that three-quarters of existing drains are defective as to their smoothness.

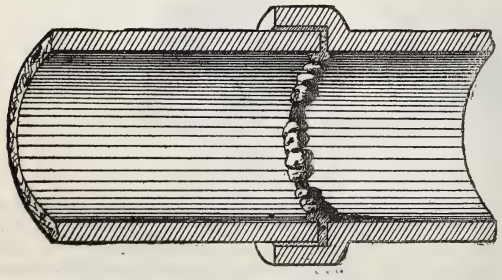


FIG. 15

The best rule in practice for the inclination of a house-drain is to give as much pitch as is possible; and in a few cases is less than one-half inch to the foot safe. A great many drains are faulty in this respect. The actual inclination of drains crossing the trench of the intercepting sewer the past year was not taken; but, of the 113 met with, 9 are recorded as level, and 14 as pitching the wrong way, that is, towards the house. One of these, coming from a public-school building, was about seven inches lower at the curb-stone than at the sewer. The condition of such a drain is shown in Fig 16 (p. 817).

The water stands in the depressed portion of the drain to the height of its connection with the sewer; and having little motion, deposits are apt to occur. In the case referred to, it is but fair to say that the school-drain was clean so far as seen. Very possibly an abundant use of water or recent heavy rains had scoured out any deposit that may have taken place. It is probable that most of this inclination in the wrong direction occurs in the street, near the sewer. The drain-layer frequently begins to put his drain simply with reference to the house, without inquiring what is the elevation of the sewer into which it is to empty. He digs his trench towards the street, and lays his drain on a slope which he judges by his eye to be sufficient. This in itself is a deceptive matter, as a trench generally seems to slope down towards the observer. When the sewer is reached, it is found to be higher than the portion of drain already laid. What is to be done? It is not the drain-layer's fault that the sewer is so high; he cannot take the trouble to dig up his pipe again; it is only a few inches any way, and the pipe is run up and connected, the trench back filled, and, "out of sight, out of mind."

It was stated that one the essentials of an efficient house-drain is that it shall be tight. Mr. Ernest Bow-

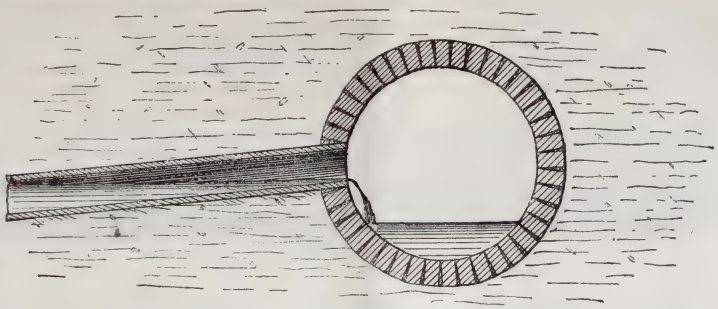


FIG. 16

ditch has called the writer's attention to a condition in which, at first sight, a leaky drain might appear better than a tight one. He says, "It is sometimes noticed, when plumbing is from twenty to twenty-five years old, and where all the drains outside the cellar walls are of open stone (technically French drains), the soil-pipe not being ventilated, that there is no perceptible leakage of sewer-gas into the house. It is reasonable to suppose that in these cases that the gas generated outside the house works up through the soil, rather than force the traps of the house. The modern method of tight drains and cesspools tends to drive all gases into the house. It is frequently more important, therefore, that recent plumbing should be ventilated than that of older date."

Both tight and open drains tend to produce evils; but those arising from a tight drain can be obviated by proper ventilation of the house-pipes, while the evils from leaky ones are irremediable. Therefore, we say, drains should be tight, that sewer-gas (or what is worse, matters capable of producing sewer-gas during a long decomposition) may not escape; and also that water may not leak out, leaving the solid contents of the drain stranded.

This want of tightness is the commonest defect of all, and probably three-quarters of the annoyance from drains is due to it. In the annual report of the Boston City Board of Health for the year ending April 30, 1878, is given the result of examinations of 351 house-drains in different sections of the city. Of these, 193, or 55 per cent., are reported as defective; and in nine cases out of ten the defect consisted in the drain not being tight. This defect, more than others, affects the better kind of houses.

Mr. Theodore Clark, who has had experience with this class of dwellings, speaks thus of earthenware and cement drain-pipes:—"These, I think, rarely remain tight many years. Even where the drains are laid with the greatest care, I have observed that water will often, in course of time, make its way out around the joints between the pipe and the ring of cement. When broken it is found that the cement has taken a perfect mould of the pipe; but either from some greasiness, or possibly a little dust on the pipe at the time of laying, it has failed to adhere, and water has ultimately forced its way through. An accumulation of water caused by an obstruction in the pipes will often scarsh out such places, which must

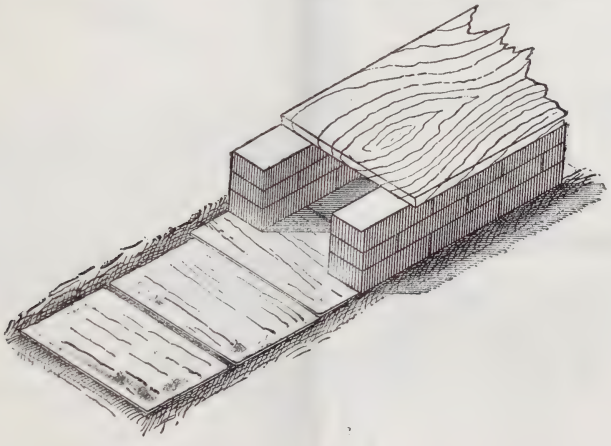


FIG. 17

have previously allowed gas to pass freely. Another very frequent source of trouble is the settling of the ground under and around the drain-pipes. In houses with drains originally in perfect condition, their joints will frequently, in a year or two, be found to be separated, the pipes cracked, or the branches settled away from the soil-pipes which enter them. In either case the drainage saturates the ground about the defective places with matter, whose effluvium will penetrate even concrete.

"In my experience, defects of this kind are far more common than leaks in iron soil-pipes, imperfect traps, or other defects attributable to the plumber; and the earthen drain-pipe should generally be first examined in searching for the cause of unpleasant smells in any part of house, as effluvia originating in the cellar often find their way through furnace-pipes and behind furrings to the remotest corners of a building."

In this connection may be cited several cases recently reported, in each of which a smell was noticed whose source it seemed impossible to locate, until at last a leak was discovered in the drain, directly communicating

with the cold-air supply-pipe of the furnace, which latter, of course, acted as a distributor of the gas through the entire house. A similar leak into the air-duct of the Boston City Hospital proved a source of serious illness, and probably of increased mortality, among the surgical patients, until remedied in course of the various improvements introduced by Dr. Cowles.

Leaky drains are due to a variety of causes. In a brick drain the joints between the bricks may not be solidly filled with mortar, the mortar may not adhere to



FIG. 18

the bricks (a common result of not wetting the latter before laying), the bricks themselves may be shaky or rotten, or the structure as a whole may be broken by unequal settling. In some drains no attempt is made to have tight joints. A kind much built some years ago, and of which many examples remain, is shown in Fig. 17 (p. 817). In this the bottom is made of roofing-slates placed side by side, or sometimes overlapping, but never with any thing to prevent water percolating through the joints into the soil below. Fig. 17 reversed, with plank

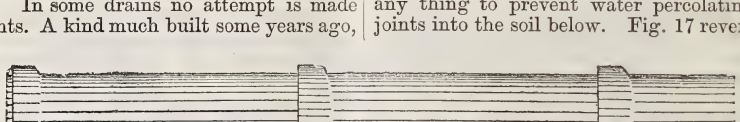


FIG. 19

below and slates above, would resemble more than half the drains on Beacon-hill as they were originally made, and still exist. A plank drain may leak through open joints, variously caused, through knot and nail holes, and by the rotting of the wood where it is not constantly wet. A pipe-drain may leak from bad joints, from flaws in the pipe itself, or because it had been broken. The breakage is generally due to unequal settling, sometimes to defective pipes, and occasionally to improper methods of laying them. The sections are sometimes carelessly or ignorantly laid on the bottom of the trench, resting merely upon their flanges as shown in Fig. 18, instead of upon their entire lengths, with depressions dug out for the flanges, as in Fig. 19.

In the former case, unless the dirt be rammed back beneath the pipe with unusual care, the pipe acts as a beam resting on supports three feet apart, and is liable to be broken by the superincumbent earth, or by any shock, as of a body falling, or a waggon jolting over it.

As the greater proportion of leaks are caused by

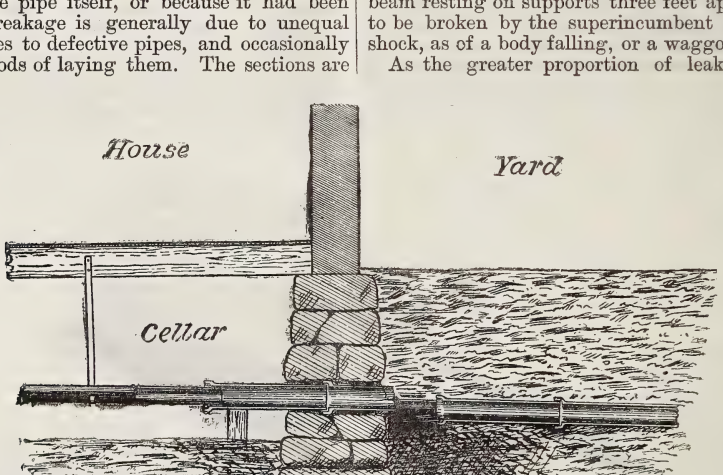


FIG 20

defective joints, it follows that a brick drain with joints every inch or two is more liable to this defect than a clay or cement pipe with joints two or three feet apart, and that iron pipe in five-feet lengths is less liable to it. A place where a leak frequently occurs, especially in a house built on made land, is where the drain passes through the cellar wall. If the foundation wall is supported, and the ground on either side settles, a condition of things is produced shown in Fig. 20.

A drain may exist in such a state as this for months or longer, without detection. The water follows the wall, perhaps into neighbouring houses, saturates the ground in the vicinity, and finally finds an outlet through some pervious stratum or into some well. If the cellar be examined, little moisture may be apparent—an ill-defined odour to which the family become accustomed, and about which visitors feel a delicacy of speaking, being the only suggestion of trouble—until finally, per-

haps, may come some "unaccountable" sickness, or "mysterious visitation of Providence." Mr. W. H. Bradley, Superintendent of Boston Sewers, spoke thus of this matter, three years ago, in a communication to the city government:—"The number of drains leaking under houses and into foundation-walls is very large; it is almost certain to occur with every house upon made land, and is always neglected by owners and tenants till it becomes insupportable; and with sickness traceable to such causes, and continued discomfort prevailing, the parties most interested still wait for the city to carry out costly general measures, thinking thus to abate their private nuisance. As a rule, a bad smell in a house means something wrong locally, and should be stopped in a day."

The examinations of house-drains, before referred to, made by the Boston Board of Health, which aimed at the discovery of leaks by the use of strong-smelling volatile oils, show that more than one-half of Boston drains (and the proportion would probably not be less elsewhere in the State) are defective from want of tightness.

To be continued.

CITY AND GUILDS OF LONDON INSTITUTE FOR THE ADVANCEMENT OF TECHNICAL EDUCATION.

During the session, commencing October 4th, 1880, Professor Armstrong, Ph.D., F.R.S., and Professor Ayrton, A.M., Inst. C.E., will continue their tutorial and laboratory courses of instruction in chemistry and physics, as applied to the arts and manufactures, at the Cowper-street schools, Finsbury, in rooms rented from the Middle-class Schools Corporation pending the erection of the City and Guilds Technical College, Finsbury. To the evening classes, Dr. Armstrong will deliver a course of about thirty lectures on "Organic Chemistry," with special reference to its industrial applications, on Mondays, at 8.30 to 9.30 p.m., commencing October 4th. The first part of the course will chiefly consist of an account of the principles of organic chemistry. After Christmas, the chemistry of the coal tar products, their uses and the production of dyeing materials from them will be very fully considered. The chemistry of brewing, spirit distilling, and vinegar making processes will form the subject of the lectures after Easter. It is especially desirable that all who propose to attend either the second or third part of the course should also attend the first part, in order to gain the necessary preliminary knowledge. To give students attending the lectures an opportunity of making experiments in connection with the subjects treated of in the lectures, and also of discussing the lectures with the professor, the laboratory will be open on Monday evenings from 6.30 to 8.30 o'clock. Dr. Armstrong will deliver a course of about 24 day lectures on Tuesday and Friday afternoons, at 4 to 5 o'clock, commencing October 5th. Although the chief object of these lectures is to afford such preliminary training as is necessary for those who may desire later on to study particular branches of applied chemistry, more than usual attention will be given to matters of technical importance. The chemistry of the more important metals will form the subject of the courses after Christmas. On and after October 4th, the laboratory will be open daily, Saturday excepted, from 10 to 1 and 2 to 5 o'clock, for students desiring instruction in special applications of chemistry. A laboratory class for students attending the day lectures on chemistry, will be held on Tuesday and Friday afternoons at 1.30 to 4 o'clock. An evening laboratory class will be held on Wednesdays from 6.30 to 9 o'clock, commencing Wednesday, October 6th. The individual requirements of students attending this class will as far as possible be considered. The photographic chemistry class will be continued on Wednesday evenings at 6.30 to 9 o'clock, commencing October 6th. It is proposed that students in this class should chiefly devote themselves to the study of spectrum photography and of emulsion processes. Professor Ayrton will deliver a course of evening lectures on electrical instrument making, on Tuesdays from 8.30 to 9.30 o'clock, commencing October 5th, the first 12 of the lectures being given before Christmas. These lectures will be fully illustrated with experiments and practical illustrations, and especially adapted to the requirements of persons engaged, or intending to engage, in this industry. The practical details of the manufacture, adjustment and testing of electromagnets, galvanometers, shunts, resistance coils and condensers will be fully entered into, and the students will have the opportunity of performing, themselves, the experiments suggested at the lectures, as well as of obtaining information from the Professor regarding technical difficulties, by attending a special laboratory course, to be held on Tuesday evenings from 6.30 to 8.30 o'clock. On Friday evenings, at 8.30 to 9.30 o'clock, commencing October 8th, Professor Ayrton will deliver a course of lectures, the first 12 being given before Christmas, on weighing appliances and motor machinery, adapted to the wants of makers and users of machinery. Professor Ayrton will deliver a course of about 24 day lectures on Monday and Wednesday afternoons, at 4 to 5 o'clock, commencing October 4th, on the electric light. A laboratory class especially suited for students attending the afternoon course of lectures will be held on Mondays and Wednesdays, at 1.30 to 4 p.m. Also on and after October 4th, the physical laboratory will be open daily, Saturdays excepted, from 10 to 1, and 2 to 5 o'clock, for students desiring individual practical instruction in technical physics.

CORRESPONDENCE.

TELEGRAPHIC INACCURACIES.—SYDNEY EXHIBITION.

In March of the present year, in our capacity as exhibition agents, we received from our representatives at the Sydney Exhibition a telegram announcing that certain firms whose agency was entrusted to us had received "first awards." As there prevailed upon the part of the firms mentioned a desire to know what shape the awards would assume, and it being usual to award gold medals to exhibitors of the first rank of merit, we telegraphed to our agents, inquiring whether such awards were "Gold," and received by telegram the answer "Yes." The purport of this answer was communicated to the firms interested therein, and in other ways made public. To our extreme mortification, several months later, we discover that the message to Sydney had been erroneously telegraphed (the word "Good" being substituted for "Gold"), and that no gold medals as those announced by us had been awarded.

The message sent by us to the Post-office, as shown by the press copy in our possession, contained the word "Gold" in unmistakeably clear writing.

The error on the part of the telegraph clerk has occasioned so much vexatious disappointment to the exhibitors and annoyance to ourselves, that we beg the favour of your making the above statement public through the medium of your columns.

Surely, means should be provided by the telegraph authorities for preventing the possibility of such serious errors, seeing that the conditions upon which messages to foreign parts are received are so arbitrary, and the expenses attending their transmission so great.

J. M. Johnson and Sons, Limited.

International Exhibition Offices, 1, Castle-street, Holborn,
2nd September, 1880.

OBITUARY.

Rev. Arthur Rigg, M.A.—Many members of the Society, more especially perhaps those who attended the courses of Cantor Lectures delivered by Mr. Rigg, will have heard with sincere regret of the death of that gentleman, which took place on the 2nd inst., at his house, in Warrington-crescent, Maida-hill. Mr. Rigg was born in 1812, at Carlisle, and was consequently in his 69th year. He was educated chiefly under Mr. Losh, at Christleton, near Chester, and in the Isle of Man, under Archdeacon Philpot. In 1832, he matriculated at Christ's College, Cambridge, graduating as 27th wrangler in 1835. Immediately upon taking his degree he was ordained, and became senior mathematical master at the Royal Institution, Liverpool, also serving as curate successively in two Liverpool churches. On the establishment of the Diocesan Training College at Chester, Mr. Rigg was appointed the principal (1839). He took an active part in organising the new scheme from its commencement, and after working in temporary premises for about three years, he moved into the buildings which had been erected for the college under his own superintendence. Under his direction, the college was soon recognised as a Technical, or Polytechnic School; for, from the first, Mr. Rigg insisted on all the students devoting a certain portion of their time to handicraft occupation. There were about 50 young men training as national schoolmasters, 70 boys belonging to a separate division in which education of a commercial character was given, and 110 daily scholars, forming a school in which the future schoolmasters were trained. Opportunity was given for the practice of many manufacturing processes, while carpentering, smiths' work, foundry work, carving, building, and agriculture were all taught, not in the school hours, but in the playtime. The workshop, to a great extent, took the place of the play-ground, and the result was that the students received a technical training, which is spoken of in the very highest terms in the inspectors' reports of the time. As instances of the work done, it may be mentioned that the pupils took a very active part in building the school chapel, even the stone being quarried by them. Steam-engines and various machines were made in the shops, all, according to competent authorities, of the highest excellence and workmanship. All this Technical Education was carried on under the direct supervision of Mr. Rigg, the only teachers being those trained by himself. To him, therefore, must be attributed the credit of having founded the first technical school in England, and indeed of having originated a system of combined intellectual and practical education, such as had never been previously tried in this or any other country. The commercial school attached to the college not only paid its own expenses, but enabled the work of the training college itself to be carried on at a diminished cost. Mr. Rigg continued his work at Chester until 1869, when he resigned his post and came to reside in London. After he left Chester, this technical work was given up, and the school became an ordinary Diocesan Training College. Mr. Rigg joined the Society of Arts in 1853, but it was not till after he came to live in London that he became closely associated with much of its work. He attended the Conference on Technical Education, which the Society held in 1868, and took part in its discussions. In 1872, he delivered his first series of Cantor Lectures, on "Mechanism." This was followed in 1873 by a course on "The Energies of the Imponderables," and in 1875, by one on "Tools and Contrivances used in Handicraft." He read a paper in 1874, on "Type-printing Machinery," and was the author of the report on machinery in the International Exhibition of 1873, published by the Society. He also wrote several communications which appeared in the *Journal*, and served on some of the Society's committees. The only original work published by him was a small volume of sermons, on "The Harmony of the Bible with Experimental Physical Science." The sermons were delivered in Chester in 1879. Mr. Rigg was an accomplished mechanician, and devoted himself principally to the study and practice of mechanics after his retirement from active work. He took a keen interest in all the proceedings of the Society, and was ever ready to assist with counsel and advice, when advancing years made him less inclined to take any active share in its labours. His last illness was a long and severe one. It began in June last, though for some years there were warnings of the diseased state of the heart, which ultimately produced the fatal illness. Mr. Rigg married, in 1837, Miss Kendrick, of Warrington; he leaves five surviving sons.

GENERAL NOTES.

Bessemer Steel Rails in Germany.—The following statistics relating to the annual production of Bessemer steel rails in Germany are taken by the *Frankfurter Zeitung* from a private estimate. The list includes the 11 great German Bessemer steel rolling works:—Krupp's of Essen, 110,000 tons; "King" and "Laura" Works, 96,000 tons; Dortmund Union, 96,000 tons; Bochum Association, 96,000 tons; Osnabruck Steel Works, 72,000 tons; "Red Earth" Works, near Aachen, 60,000 tons; "Phœnix" in Ruhrort, 60,000 tons; "Good Hope" Works at Oberhausen, 60,000 tons; Horder Association, 60,000 tons; "Queen Mary" Works, 60,000 tons; Bayreuth "Maximilian" Works, 50,000 tons; total 820,000 tons.

Gas Furnaces.—Mr. Fletcher, of Warrington, has brought out a modified form of one of the gas stoves shown by him to illustrate the paper he read last session on this subject. The improvement consists in substituting a perforated dome of copper in place of the wire-gauze disc, usually employed in this and similar gas stoves. The object of this is to enable it to be readily removed and cleaned. The stove is fitted with the atmospheric gas-burner, termed by Mr. Fletcher the "injector burner," in which the entering current of gas is caused to draw with it a sufficient amount of atmospheric air, the mixed air and gas being then conducted along a horizontal tube, and discharged under the gauze or perforated copper, on the exterior of which it is burnt.

Sanitary Institute.—The autumn Congress of this institute will be held at Exeter, from September 21st to the 25th, 1880. An exhibition of sanitary apparatus and appliances will be held from September 21st to October 9th. The President of the Congress is Lord Fortescue. There are three sections of the Congress:—1. "Sanitary Science and Preventive Medicine" (President, Professor F. S. B. F. De Chaumont, M.D., F.R.S.) 2. "Engineering and Sanitary Construction" (President, Robert Rawlinson, C.B., M. Inst. C.E.) 3. "Meteorology and Geology" (President, Sir Antonio Brady, F.M.S., F.G.S.) In addition to the sectional meetings, a lecture will be delivered to the Congress, by Dr. B. W. Richardson, LL.D., F.R.S. The Council of the institute invite papers on subjects connected with State medicine, including engineering and sanitary construction, meteorology and geology, sanitary science and preventive medicine. No previously published papers can be read. Each author must prepare an abstract of his paper and send it, together with the original MSS., by book-post, on or before September 1st, addressed Secretary, Sanitary Institute of Great Britain, 9, Conduit-street, Regent-street, W. Authors whose papers have been received and accepted, will be furnished with printed copies before the commencement of the Congress.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,452. VOL. XXVIII.

FRIDAY, SEPTEMBER 17, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

LECTURE I.—DELIVERED MONDAY, APRIL 5TH.

Introductory.

In accepting the invitation of the Council of this Society to give a series of lectures, on "Decoration and Furniture applied to ordinary Town Houses," I am quite aware that these subjects have, in the last few years, been lectured and written upon almost *ad nauseam*, and I might well hesitate before entering an arena in which there is, and must always be, an immense difference of opinion as to what is best and most artistic for the decoration and furnishing of the houses we live in.

For some years past, I have given the subjects of art decoration and furniture my special study, have lectured upon them at different times, and written numerous articles which have appeared in the pages of various journals; and in the course I am now about to give, I propose to enlarge materially what I have already spoken and written upon the subject.

In the various suggestions I may offer you, I am desirous of putting forth no dogmatic rules, of laying down no stringent laws from which there shall be no departure; but rather to offer some practical hints to those who are seeking to depart from the general commonplaceness and vulgarity of design in decoration and furniture of our modern houses. I do not desire to enter into any battle of styles, believing that true beauty and art-form are dependent upon no particular style—Classic, Gothic, or so-called Queen Anne—and that in the houses we live in it is first of all essential that everything shall be as fitting as possible, and that extravagance of all kinds, or so-called high art, shall be subservient to comfort, truth of construction, utility, and general convenience.

In addressing an audience representing the more educated portion of the public, I am most anxious to impress upon you the desirability of having everything about you beautiful in itself, and fitting for its special purpose, and that, however commonplace the object, it shall be good in form, design, and colour, and that the present craving, if I may so call it, after artistic work in decoration and furniture, shall not degenerate into any set fashion of form or colouring, which, under the clap-trap denomination of "high art," is utterly false and unreal.

You do not, I presume, want to make show places of your homes, in which the fashion of an hour shall be exemplified in the various monotonous dreariness of sage greens and peacock blues in papering, or in quaint eccentricities of design and form in furniture, and which, in a few short years, will be looked upon as crude and tasteless.

In this country, where the love of home life and its teachings of domestic comfort and peace especially pertain, all questions of decoration and furniture must necessarily be more or less influenced by these conditions; and we cannot expect, in an age in which there are so many causes to influence opinion, to obtain any special unity of taste, or to have that strong harmonious feeling which brought about the great schools of religious painting in the Middle Ages.

It is the fashion amongst a certain class of artists of the present day to decry all modern art, and to seek for ancient examples, Greek, Roman, mediæval, or Oriental, on which to found their ideas of decorative art in the present day; but I cannot but think this arises from a feeling of shame at their own incompetence, and a desire to slur over their own ignorance by feeble attempts to copy the art of other countries.

The work that we have to do to-day, is not to be content, as Lord Aberdeen says, "with the timid and servile hand of the copyist, but with a due regard to the changes of customs and manners, to the difference of climate, and the conditions of modern society," to adapt the art work in our houses so that it be beautiful, fitting, and suitable.

Thanks to the great progress made in the chief arts of architecture and painting in the last quarter of a century, to the general advancement of technical education throughout the country, by the establishment of the Government School of Design at South Kensington, with its numerous metropolitan and provincial branches, and to the great number of loan collections at home and abroad, there has been increased opportunity of studying art of all kinds, and more especially of those offshoots of architectural art which are known generally under the name of "decorative arts."

The various exhibitions in this country and on the Continent in the last few years have exercised an immense influence on the taste, not only of the public, but of the workmen in all the crafts of British industry, more especially associated with the industrial art of the country; the innumerable beautiful examples of ancient art productions of all countries, and the mass of publications illustrating them, have set us all to think more of the things of everyday life in our homes, and by their teaching, have gradually imbued all classes with a desire and love for beautiful form and colour, and a distaste for the crude vulgarities and hideous forms with which we have been for so long content.

Too much praise cannot be given to the Society of Arts, for the conscientious way in which they have for long years steadily sought, by all the means in their power, to foster and encourage the cause of art and science; from their exertions and initiative have sprung up most of the schools

of practical art-teaching throughout the country; and it is but fair to remember that this Society, soon after its foundation in 1754, set itself to promote the more intelligent study of science and art, by offering prizes in the classes of what were then called the "polite arts" of painting, drawing, and sculpture; and, even at this period, offered further prizes for the arts applied to industry, in patterns for weavers, calico printers and furniture; by which, as evinced in the reports of the Society, much real good was obtained, and a manifest improvement in design. As the Royal Academy and other kindred societies increased in power, the arts of painting and sculpture became more under their especial management and control, until in 1843, when the late Prince Consort—whose never-flagging endeavours to improve the domestic arts of this country must always earn for him a lasting gratitude—became President of the Society; and, through his advice and influence, the Society took up the especial work of developing the application of the Fine Arts to manufactures; and the outcome of these efforts was to produce the 1851 Exhibition, and, at the same time, conjointly brought about the establishment of the earlier schools of design, from which sprang the present great school at South Kensington, and the present system of art education.

In praising the present schools, I must take exception to some of their teaching. I cannot see why it is necessary to make students work continually upon designs of repeated geometrical forms —in which there is an absence of all true artistic feeling—which are called ornamental, or in the striving after what has been justly called "a mere photographic correctness in the studies, both from the flat and from the round," in which there is no beauty or life, and which tends to engender a stiffness and conventionality of treatment in all after-work. All this is machinery work of the hand, and loses all trace of human mind or thought; for if art work is worth anything at all, it must be not in the production of slavish repetition of some set pattern, but in the skilful and artistic rendering of ornament, in which, while it may be necessary to keep up a certain line of decorative treatment, there shall be no everlasting sameness and repetition of drawing or colouring; the same line of scroll work may be treated with some diversity of colouring and drawing, and yet be as harmonious, in tone and general effect, as the same work continued with exact repetition of form and shade.

I do not here advocate the teaching of some of our eccentric school of artists, if I may call them so, who hold that no line or shade shall be repeated, or that we shall make our walls "studies" in any particular shades of colouring.

Unfortunately, it would seem that to a great extent the present opportunities have not brought real life or real pleasure with them, but have worked out a fashion—a painted pretence and sham —worse even than the fashion of dress; and the decorative arts seem likely to depend rather on luxury and fashion than on any real love of art. Hence has arisen a race of so-called decorators, who, working with little knowledge and less love, are, under the name of "art decoration," creating a fashion of design and furniture which is worse even than the dead days, when people were content to see around them the ugliest forms, the meanest designs, and the dreariest of colours. We must have care that so-called "art decoration" does not degenerate into the feeble prettinesses of ignorant designers, into the fashion of so-called "art papers," or the flimsiness of furniture imitated or copied from Japanese or Eastern examples, and having no element of real culture or imaginative power of mind, associated with skilful and loving work of hand and eye. Without doubt there is, on the part of the educated classes, a desire to have in every-day life, and in the houses they live in, furniture and decoration which shall have some real feeling for truth of construction, beauty of form, and general harmony of colour. But if we are to have decoration, let it be of the best kind; if we must imitate, let us seek for the best examples; and, above all, if we are able to afford figure decoration of any kind in our rooms, let it be of the best type, well drawn, treated as flat decoration, not as easel pictures, and not quaint and angular models, dressed up in varied anachronism of ancient dress. The houses we live in are, after all, the main teaching of our lives; and I am confident that no amount of outside teaching can help forward the love of beauty and truth in form and in colour, so much as the proper and decent arrangement of the rooms and belongings which are continually before us.

While for years past there has been a revival in all work, specially pertaining to ecclesiastical decoration and furniture, the subject of house decoration, until quite recently, has been signally uncared for. It is unfortunate that we cannot be content to study the art work of other nations without seeking to plagiarise from it, or to adapt its form and colour in our own manufacturers and designs. Nothing can be more beautiful in itself than the art work of India, China, and Japan, whether applied to textile fabrics, carved and painted wood work, pottery or porcelain, gold and silver, or lacquer work; but nothing can be more atrocious than the imitations with which we are now-a-days inundated. Nothing can be worse than art at second-hand, more especially when the associations and feelings of the two sets of workers, the original and the imitators, are totally different. In the study of all Oriental art we can gain infinite knowledge of skill and grace of design and workmanship, and power and beauty of drawing and colouring; but the art-workers of this country are no more able to imitate these attributes, which we admire so much, than they can fly; and when we hear of rooms decorated with imitation Chinese bamboo work, and tinted sealing-wax, red and gold, with splashes of blue and green, in imitation of Japanese lacquer, we can only regret that the time and money thus wasted, in fruitless endeavour to obtain what at its best must be but a bad imitation, should not be applied to decoration and drawing more in keeping with our own associations and surroundings. We may receive a higher and better influence in decorative taste by studying the art-work of Oriental nations, but we can never attain to any true artistic character of work, by slavishly copying the design and colouring of artists who worked under totally different associations and traditions.

It was lamentable to notice in the Indian collection at the last Paris Exhibition, the numerous examples of mongrel work, the result, as Dr.

Birdwood, in his valuable hand-book, says truly, "of the influences on Indian art of English society, missionary schools, schools of art, and international exhibitions, and above all of the irresistible energy of the mechanical productions of Manchester, and Birmingham, and Paris, and Vienna." This was especially noticeable in the Prince of Wales's collection, in the way in which the native chiefs and princes, "in many instances despising their own arts, had literal copies executed in solid silver" of the latest Birmingham imitations of Indian pattern tea-pots, paper weights, and centre pieces.

Indian rugs and shawls have noticeably degenerated through the same bad influences; Cashmere shawls are no longer the exquisite productions of the spontaneous art feeling of the Indian workman, but are based upon the "improved shawl patterns" which French importers have laid before them. The design and colouring of the rugs and carpets which are now sent over, have been materially damaged by the Government practice of making the prisoners, in their Indian jails, enter upon the lucrative trade of carpet making, and thus, to a great extent, extinguishing the caste weavers, with whom has perished, let us hope not for ever, the local traditions of their art. The carpets thus made are poor in quality, compared with the old examples, and the colours and patterns are crude and bad.

To quote Dr. Birdwood again:—

"Of late years the shop-windows of Regent-street and Oxford-street have been filled with electrotype reproductions of Burmese, Cashmere, Lucknow, Cutch, and Madras silver and gold work, along with Manchester, Coventry, and Paisley imitations of Indian chintzes, kincobs, and shawls. This is simply to deprave and debase English manufactures and English taste. No people have a truer feeling for art than English men and women of all classes, or purer elements of a national decorative style and methods; and the right and fruitful use of looking at superb examples of Indian jewellery, tapestries, and pottery, is not to make literal copies of them, but to kindle the sense of wonder and imagination in us to nobler achievements in our indigenous and industrial arts."

It is impossible to slavishly copy the distinct and indigenous varieties of Oriental decorative arts with any satisfaction in the decorative work of this country, although it is quite possible to learn much from their exquisite design and treatment, and to use and adopt (as I shall hereafter describe) some of their work in the decorative and ornamentation of our own homes.

If a man may be judged by the friends he has, surely much more so may his artistic culture and love of beauty be arrived at by the nature of the things with which he surrounds himself in his home. It is unfortunately true that, in many houses, we still find decoration and furniture in which there is no element of beauty, in which costliness and vulgarity seem to run together, while some of the modern teachers run into eccentricity and grotesqueness of design and colouring, forgetting that in art, as in every-day life, eccentricities, either of design or colouring, are to be avoided, and that, as in the well-dressed woman of our acquaintance, so in all art decoration, we should be able to see general harmony and simplicity of effect, in which there shall be no glaring patterns or colours.

The fittings, hangings, and general furniture of a room should not only be fitting and suitable for their various uses, but in harmony with the general decoration of the walls, and this decoration should depend not upon any fashion or style, but on the general appreciation and adoption of colour and beauty of form, and withal ensuring a home-like feeling, made more beautiful and interesting by the imaginative taste and daily art education of those who live in our homes.

Depend upon it, the decoration of our houses is not a mere thing of fashion, but a constant recurring pleasure, and beyond all this, to a great extent, the absolute art education of all who dwell within or visit us in our homes.

Since the latter days of the Renaissance, when practically set in the decadence and fall of all real art, there have been sundry fashions in architecture, painting, and decoration which have had a short and fitful life, giving way, like all fashions which are grounded on no love or real feeling, to the caprice and taste of the last new comer. From the end of the sixteenth century we have gone through many phases, from Classic to Gothic, and from Gothic to Queen Anne. We had for a long period an affectation of a classic taste, when the decoration of Pompeii was imitated *ad nauseam*, but without understanding or knowledge of the principles of the art; the walls were overladen with heavy colouring and gilding; and in furniture, comfort and utility were sacrificed to classic forms. To quote a late writer on art:—"Furniture, fire-irons, teapots, and the various objects of daily domestic use, made after the manner of the ancients, could scarcely be turned to their legitimate purposes, however well adapted they may have been to the sacrifices of a Greek or Roman temple. Chairs and sofas strictly made upon the model of the *sella curulis* and the bronze *bisellium*, might have been comfortable in the Forum, but were execrable in the drawing-room. We were at last driven out of the Classic; we could neither eat, drink, nor sit in comfort."

Then came the Gothic revival, and in furniture we exchanged the curule chair for the "narrow seats and the knobby backs," not more comfortable or pleasant to our persons than the ancient "sedilia;" nor can much be said for the carved cabinets, ponderous sideboards, and imitation mediæval furniture, constructed, of course, "on unexceptionable authority, after the true fashion of our ancestors." And now has set in a fashion dedicated to her most sacred Majesty Queen Anne, a fashion which has developed much of really good art character, and which, after all, properly applied, is really bringing us back to old English work. Amongst the more educated professors of the style, we find at present many pretty conceits which are not worthy of the name of art; but we also find good construction and carefulness of design, which we may hail as forerunners of better times, and more artistic work. It is but fair to say that to Messrs. Street, R.A., E. W. Godwin, W. Burges, P. Webb, Norman Shaw, R.A., and other architects, and to Messrs. Morris and Co., Messrs. Crace, Messrs. Gillow, Messrs. Jackson and Graham, Messrs. Jeffrey, and other well-known firms, much praise is due for their efforts in the cause of artistic design in decorative hangings and furniture.

I do not intend to treat my subject from any point of view in which money is no object, but to endeavour to show that good artistic work may be done as reasonably as bad work, and that beauty of form, colour, and design may be as economically applied to house decoration and furniture, and with infinitely more satisfaction, than the vulgar hangings and commonplace furniture to which we have for so many years been accustomed.

In these days of luxury and artistic proclivities, large sums of money are spent upon internal decoration and furniture, without much idea of taste or common sense; money is frittered away in pretentious extravagance, in the shape of gaudy decoration, or elaborately carved and inlaid furniture, and hangings of most expensive character, which have little or no real claim to be called artistic or beautiful; a profusion of elaborate ornament is recklessly thrown upon the walls and ceilings, without knowledge and without taste. In olden days, good art did not mean prodigality of colouring, and endless covering of wall or ceiling space, with pattern work in various colours, but was made, as a rule, consistent with the requirements and associations of the period, whether in domestic or religious life; nowadays we are too apt to be content to accept the dogmas of a particular school as correct and infallible, and to forget that the true art decoration of houses is not to be made up of fashionable wall papers, or furniture made after a particular pattern, but is dependent upon the smaller surroundings and articles of daily use. Nor is extravagance of cost necessary for the fitting up of our houses, for I hold that furniture of thoroughly good art design, comfortable in shape, and good in workmanship, may be made without any extravagant outlay, and that plain polished or painted deal furniture, of really good design, is better than all the elaboration of Chippendale fretwork or Queen Anne ornamentation. The pretentious imitation of old work in furniture is in every way to be condemned; and I cannot but quote here the words of M. Violet le Duc, who, in his "Mobilier Française," says, speaking of modern work generally—

"Amongst all these cheap splendours of false taste and false luxury, we are delighted when we find a seat really well made, a good oak table thoroughly strong on its legs, woollen curtains which really look like wool, a comfortable and solid chair, a cupboard which opens and shuts well, showing us inside and out the wood it is really made off, and the object for which it is intended; let us hope for a return to those healthy ideas, and that in the making of furniture, as in everything else, we may come to understand that true taste consists in appearing that which one is, and not that which one would wish to be."

I can conceive nothing more terrible than to be doomed to spend one's life in a house furnished after the fashion of twenty years ago. Dull monotonous walls, on which garish flock papers, of the vulgarest possible design, stare one blankly in the face, with patches here and there of accumulated dirt and dust, or the even worse monstrosities of imitation *moirée* silk, with bunches of gilt flowers tied up with gilt ribbons, and running in symmetrical lines, all carefully-sized, like soldiers on parade. Of course, if the flock paper be red, we had red curtains hung on to a gigantic pole, like the mast of a ship, blossoming out at the ends into bunches of flowers or turned finials, like enormous hyacinth bulbs in water. Of course the curtains trailed some feet on the floor, and, when not taken possession of by the pet dog or cat, became the receptacle for dust and dirt, or the hiding place of the remains of some pet's dinner. The chairs were covered with red stuff of some kind; the table had a red cloth, printed all over with elegant designs of flowers in black, in impossible positions; the carpet also was probably of some gaudy colour and pattern, covering the whole room with a sprawling pattern of gigantic flowers; the furniture of the stiffest possible kind; rows of chairs, seemingly propped up against the wall in straight lines, not to task over much the bandy-curved legs which bore them, the so-called "shaped" backs cut cross-grain of the wood, so as to snap sharp off with any extra weight; an enormous glass over the miserably ugly mantel-piece, in a still more enormous gold frame, with bits of cast plaster ornament, also gilt, stuck on like bats and rats on a barn door, and like them, showing signs of decay and decomposition; a so-called sideboard, with a drawer in the middle, a cupboard on each side, and another enormous glass over head. In the drawing-room, we had the same kind of monotony, only, perhaps, in a different colour; a green carpet, with peaceful lilies intertwining with each other; a hearthrug, with a Bengal tiger ill at ease, with his back to the fire, and his face to the lilies; and a footstool, covered with Berlin wool, representing the pet dog of the period, very much astonished at his proximity to the aforesaid tiger; green curtains, with a Greek fret or honeysuckle border in gold; a gigantic valance, with deep fringe worked into knots over turned wood beads; furniture covered with work of crude colours, marriage offerings to our fathers and mothers; chairs so lightly constructed that you could never be safe upon them; couches that you could not lie comfortably upon; tables with legs twisted and turned into impossible shapes; occasional chairs, which were well named, because they would never stand for the purposes they were intended, except very occasionally indeed; and the whole arrangements of the room stiff, formal, and uninviting; the worsted work and the silk or rep covering, tied up, as a rule, in dingy linen covers, and a general air of discomfort and unsociability. Who can wonder that people lived but little in their drawing-rooms. If there was a bit of colour on the walls, nine times out of ten it was of the tea-tray character, a brilliant illumination of Vesuvius as it would probably appear at a pantomime, and not in reality; a few family portraits, whose particular merits were spoilt by the painting, and everything miserable and unartistic; so that when you got up the staircase, with its walls made cold and dingy by blocks of imitation marble, if one had any taste at all, the very appearance and tone of the room almost cowed one into silence, or froze one into mere commonplaceness.

Vexatio dat intellectum, and it is not to be supposed that any true knowledge of decoration, and real feeling for things artistic, can be obtained all at once; it is only by a constant study of nature, and of the really beautiful things of art, that the eye becomes educated to understand and appreciate beauty of form, outline, and colour. Foremost

in the very rudiments of real art, it must be borne in mind that absolute truth must be the foundation of all good work, that all ornament should consist of the enrichment of the real construction of the building, that this should in itself be beautiful, and that decoration itself should not be constructed for mere purposes of show and effect, and should possess in itself fitness, proportion, and harmony of design and colouring.

Speaking of our houses, the late Mr. Owen Jones, in his "Grammar of Ornament," truly says:—"Architecture is the material expansion of the wants, the faculties, and the sentiments of the age in which it is created," and "the decorative arts should possess fitness, proportion, and harmony," so as to bring about that proper and necessary "repose which the mind feels when the eye, the intellect, and the affections are satisfied."

If we examine any of the work of past ages, either in textile fabrics, furniture, or decoration, we shall see that truth and fitness in design and construction, and harmony in colour and arrangement, are carefully carried out; that there is no sham or imitation, but, so far as practicable, the work is essentially real and true. To carry into our houses the shadow of unreality, by graining or marbling in imitation of the real materials, by giving to cast iron the semblance of wrought, by putting up papers painted to represent various woods, tiles, or marble, is simply teaching a lie, and asserting, in the worst possible taste, the semblance of a truth which does not exist; and when the best graining or marbling in the world is done, it is but a miserable satire on the real material. All striving after imitation and unreality is utterly at variance with good taste, in decoration as in life. I do not wish to enter into the moral aspect of the matter, but the words from the chapter on "Moral Influences of the Dwelling," in the "Recreations of a Country Parson," seem here singularly appropriate. Speaking of our homes, the author of this charming little book says:—

"I think it is now coming to be acknowledged by most rational beings, that houses ought to be pretty as well as healthy, and that houses, even of the humblest class, may be pretty as well as healthy. By the Creator's wise arrangement, beauty and art go together; the prettiest house will be the healthiest, most convenient, and most comfortable; and I am persuaded that great moral results follow from people's houses being pretty as well as healthy. * * * It makes an educated man domestic; it makes him a lover of neatness and accuracy. * * * Taste costs nothing. If you have a given quantity of building materials to arrange in order, it is just as easy, and just as cheap, to arrange them in a tasteful and graceful order of collocation, as in a taskless, irritating, offensive, and disgusting one. * * * And in this æsthetic age, when there is a general demand for greater beauty in all physical appliances; when we are getting rid of the vile old willow pattern; when bedroom crockery must be of graceful form and embellishment; when grates and fenders, chairs and couches, window curtains and carpets, oilcloth for lobby floors, and paper for covering walls, must all be designed in conformity with the dictates of an elaborate taste, it is not too much to hope that the day will come when every human dwelling that shall be built, shall be so built and so placed that it shall form a picture, pleasant to all men to look at."

I am quite sure that all things that show what they really are, and do not pretend to be something else, are in the end best and cheapest. It may be said that, within the last few years, the public have had little or no chance of getting rid of vulgar designs in wall hangings, curtains, carpets, and furniture, and that if they wanted to obtain better work, the cost of purchasing real Indian or Persian rugs, or of having furniture designed, was utterly beyond their means; and with every desire to see better work in their houses, the knowledge and taste of the manufacturers of the various objects were so limited, that they were content to keep to the old patterns, or to put forth others which were equally vulgar and commonplace. For long years we have been content to have the furniture and fittings of our houses unartistic and commonplace, and, as Mr. Eastlake says in his very useful, and well-written book on "Household Taste," this commonplaceness "pervaded and vitiated the judgment by which we were accustomed to select and approve the objects of every-day use in our houses. It crossed our path in the Brussels carpet of our drawing-rooms; it was about our beds in the shape of gaudy chintz; it compelled us to rest on chairs and sit at tables which were designed in accordance with the worst principles of construction, and invested them with shapes confessedly unpicturesque. It sent us metal work from Birmingham which was as vulgar in form as flimsy in execution. It decorated the finest modern porcelain with the most objectionable character of ornament. It lined our walls with silly representations of vegetable life, or with a mass of uninteresting diaper. It bade us, in short, furnish our houses after the same fashion as we dress ourselves, and that is with no more sense of beauty than if art were a dead letter." This utter want of taste, and general love of meretricious and vulgar show, ramified through everything, from the art of architecture, to the meanest object of every-day use. What wonder then that there was little appreciation of art or taste, or any refinement of culture or feeling, and that, while in other countries art-manufacture of all kinds was infinitely superior, our own productions were utterly thrown into the shade, and art in domestic life was almost a thing unknown.

In decoration and furniture the great aim of the designer should be simplicity and appropriateness of form and design, with harmony of colour, and to show that the cheapest and commonest things need not be ugly, and that truth in art and design need not of necessity involve costliness and lavish expenditure. Fitness and absolute truth are essential to all real art, and be it remembered that "design is not the offspring of idle fancy; it is the studied result of accumulative observation and delightful habit;" and by a careful regard to this, we may make our homes and habitations, if not absolutely shrines of beauty and good taste, at least pleasant places, where the educated eye may look around without being shocked and offended by gross vulgarity and gaudy commonplaceness.

It fell to my lot to have to review very many of the exhibits in the last Paris Exhibition of trades specially cognate to art, and I consequently had to examine more closely than I otherwise should have done into the various articles of every day use, as to their design, workmanship, and cost, and I am bound to say that, although there was much that showed enormous progress in art design and skilled

workmanship, I found little or nothing which, to my mind, in any way solved the all-important problem of providing really good and artistic furniture at a moderate cost, so that it might be within the reach of all classes of the community. There is no real reason why painted and varnished deal, or other soft wood, furniture should not be made at a cost within the means of all. Messrs. Morris and Co. have designed an excellent chair in stained wood, comfortable, and artistic, although, perhaps, somewhat rough in make, for 9s. 9d.; and I have seen buffets and book-cases made in deal at the cost of a few pounds which look well, and answer the purposes for which they are required.

There are innumerable examples of cotton and chintz of excellent colouring and pattern, which can be bought for a few shillings a yard, and well designed and drawn papers at a mere nominal cost, compared with the expensive French imitation silk and gold examples of a few years back; and plain painted furniture, of good form and appropriate design and arrangement, which can be obtained from almost any real good upholsterer, in place of the more elaborate polished mahogany erections with which we have so long been familiar. Good Oriental rugs can be purchased for small sums, and, in combination with painted floors or India matting bordering, can be made to cover the floor spaces of our rooms quite as inexpensively as a Brussels or Wilton carpet laid all over the room.

For more than a hundred years, the fashion of furniture, like that of the master art of architecture, has been continually changing, and from time to time we have had works which have either been adapted or imitated from ancient Greek or Roman examples, or in later years have based their form and shape on mediæval specimens, degenerating, as a rule, into vulgar and meretricious commonplaces, in which seeming quaintness, stiff angularities, and eccentric and uncomfortable cutting and projections, did duty for the more elaborate, although equally uncomfortable, finishing of the real work. The age of Batty Langley produced furniture as false and meretricious in taste as the rooms it was designed to fill. The later rococo period of *pseudo*-Italian work, in which compo was made to do duty for real stone, and whole rows of houses were erected in the most approved forms of vulgar commonplaceness, brought back the vulgarity and senseless imitation of the worst period of French upholstery. In still later days, arose the fashion of so-called mediæval furniture made to fall in with the revival of Gothic architecture, but based on no real knowledge of the actual specimens of the furniture of the Middle Ages, which, with all its elaborateness and richness of design and materials, and all its gorgeousness of colouring, would be no more suited to the domestic life and habits of the nineteenth century, than the cramped and ill-arranged smaller houses of the Middle Ages, as shown by the examples still remaining to us, would be suited to the wants and requirements of present times. If not an age of luxury, the nineteenth century is essentially one of comfort; and the tile-pavements, with sweet scented straw or heath strewn upon them, the divans and wall benches, the ingeniously carved, but withal uncomfortable, chairs and tables, the walls hung with rich carpets or tapestry, are totally unsuited to modern wants and ways of living. In the eighteenth century the work of the upholsterers in England was much influenced by the designs of Chippendale, Sheraton, Adams, and Pergolesi; and in these we find as a rule general utility and comfort, combined with skill and delicacy in design and excellency of workmanship.

So far, the present fashion of architecture has caused us to hark back to the work of these designers; and in much of the furniture of the present day their influence is clearly shown.

In furniture, as in almost everything else in the last two centuries, there have been frequent changes of fashion, depending rather upon the caprices than the absolute necessities of society. In early days, when our ancestors were compelled to hold their own by force of arms, to shut themselves up in strongly built and fortified castles, and were of a necessity compelled to be ready to flee from the successful raids of hostile forces, the principal furniture consisted of chests, and many a massive iron-bound box, which although made to defy all attempts to open, must yet, in the days when carriages were of the clumsiest character, have been somewhat hard to move. After these days, to quote M. Jacquemart:—

"By degrees, as public security increased and society, growing more condensed, found support in its legal organisation, ease began to develop itself, and with it luxury, that innate want of intelligent races, who require the satisfaction of the eye in proportion to the enlightment of the mind. Strictly speaking, therefore, it was not until after the strifes of the Middle Ages that furniture, such as we understand it in our day, could have existed, that is, an assemblage of objects placed in the principal divisions of habitation, to satisfy the different requirements, and present at the same time an agreeable, elegant, and even splendid appearance."

It is curious to notice how much furniture, like architecture, speaks in plain language the history of a country; and as nations increased in wealth and civilisation, the luxury and gorgeousness of their furniture increased; while the design and form of many of the pieces, to a great extent, marked the customs and forms of the particular people. The "triclinium" of three seats of the Romans, marked the late Oriental fashion of reclining at meals. The ancient Greeks and Romans, moreover, divided their household furniture into various heads; first, the articles devoted to domestic religious sacrifices; secondly, the ornaments worn on solemn festivals by the women, who, in those days, were placed immediately after the gods; and then, in rotation, the sacred robes and military armour of the men, the looms and spinning wheels, cooking utensils, and the various services of plate or porcelain, which were, even as now, divided into those for general use, and those for grand occasions. The chairs used by the Greeks were elegant in form and graceful in design, and of materials varying in costliness according to the means of the owner; in the examples shown on ancient gems and bassi-relievi, we see the straight-backed chair, or the thrones of their gods, all more or less like the high-backed chairs of the Elizabethan period.

I must be forgiven if, as an architect, I regret that in these days the designing of furniture is, as a rule, handed over to the upholsterer, and that the houses we build are oft times filled with articles

incongruous in design, bad in taste, and utterly commonplace and uncomfortable. This criticism does not apply to some of our principal manufacturers, who have striven to lead the public into more artistic thoughts, and have provided for them work which is at once good in design and treatment, graceful and pleasant in form, and finished in the highest possible way, both as regards artistic character and skill of handicraft. But these gentlemen, like other artists, have a cloud of imitators, whose works are set forth as of "old English," "Queen Anne," or some other special and equally applicable period or fashion, and which, while aiming to be cheap, are equally commonplace and nasty, and are filled with carvings of the most execrable character, or some miserable painted daubs, bad in drawing and in colour, which are made to do duty as panels, and are set forth as high art; and from their gaudiness—or, if you like it better, eccentricity of design—commends themselves to those whose taste is not of the highest kind, but whose ambition to possess gaudy finery, and something to show off, is great and insatiable.

The various discoveries of the paintings on the walls of buildings at Thebes and neighbouring districts, and at Pompeii and Herculaneum, give us a very fair idea of the furniture of ancient Egypt and Italy. The Egyptians undoubtedly had handsome inlaid seats of various kinds, made of ebony and other rare woods, and often covered with rich stuffs, sometimes with leather, fancifully decorated. The legs were carved into the resemblance of those of animals, and sometimes would seem to be solid, and painted with figures of captives, indicating a degrading position. The pillows would seem to have been of wood hollowed for the head; the tables were of all forms, generally circular, as being more social and comfortable; and, so far as we can ascertain, the furniture of ancient Egypt was more or less like that of the present day, while modern Egypt is content to have an Oriental form of arrangement, in which low divans and mats form the principal items.

In the sixteenth century, furniture practically became more solid and less moveable, and from this period dates the designing and making of elaborate inlaid and carved furniture of every description, until, in the time of Louis XIV., was inaugurated, so to speak, an age of pomp and luxurious magnificence in all articles of furniture and decoration, gradually leading, as all such work as a rule leads, to the whimsical extravagance and ugliness of form, and to the costliness of metal chasing and elaborately gilt bronze decoration, known generally under the name of its inventor, "Buhl," in which, while we cannot but admire the exquisite workmanship and, in many instances, beautiful and spirited conception and design, there is little of real use or homelike character. In later days, we see a return to the purer work of the Renaissance, simplicity and delicacy in design and ornament; and, in the seventeenth century, the use of porcelain of Oriental design and make was largely employed, until, under Louis XVI., the beautiful porcelain *plaques* of Sévres were substituted for Oriental panels, and the delicate colouring and exquisite painting of these, intermingled with exquisite veneerings of various coloured woods, and the finely wrought bronze work, beauteously gilt, worked out with great beauty of design and general harmony of treatment. About this time were made many of those marquetry cabinets, in which various woods were skillfully inlaid in endless designs and shapes. All this kind of furniture had in its particular style great beauty and charm, but it was eminently costly, and, as a rule, all modern imitations lose, from want of skill of handicraft, and power of decorative design and treatment, all character, and are like the mediæval examples of Wardour-street, things to be avoided rather than encouraged or sought after.

I have thus briefly sketched out the history of furniture with no idea of suggesting its influence upon our modern work, in which different necessities and different habits require different treatment. In my future lectures, I propose to offer suggestions for the economical treatment of decoration and furniture, and the adaptation of both to modern necessities, rather than to discuss with what elaboratenesss and gorgeousness decoration can be carried out where money is no object.

I shall be satisfied if in my lectures I may set any of you thinking more about the art decoration and furnishing of your homes than you have done hitherto, and if I can show you that good art is not necessarily costly, nor a mere fashionable plaything, but something which, rightly carried out in everyday life, leads to higher, nobler, and better thoughts.

It has been well written that—

"The law of development under which nature perfects her types should also be the law of art, and the error into which revivalists fall is that of going backward in the order of creation instead of forwards. The one broad line of distinction between Classicists and Gothicists would seem to be, that the former seek abstract beauty, an ideal and perfected type, while the latter seize upon accident, character, and eccentricity. The remedy lies in the more intelligent study of nature."

The present revival, in good hands, is working back to truth of construction, boldness of composition and treatment, and strength and grace of drawing. Thus may we hope that styles small and puerile will give place to manners great and manly, and that our English art in decoration and furniture may eventually return to those days in which truth and study of nature, combined with knowledge of use and suitability, were the chief attributes of all good and pure design. And now that the Government is dealing in a measure with the art education of the people, and the knowledge of good and evil in drawing, design, and colouring is being largely disseminated, let us hope that the fine arts, as applied to the internal decoration of our homes, as well as to architecture, sculpture, and painting, may be felt as the higher intellectual agents in fostering and promoting the well-being of man.

MISCELLANEOUS.

HOUSE DRAINAGE AND SEWAGE WORK AS A SPECIALITY.

(*Continued from page* 819.)

A drain should be firmly and properly connected to the sewer at one of its ends, and to the soil-pipe (if

this connection be within the house, as it almost invariably is) at the other. More leaks probably occur at the other place than at any other. The inspectors of the Board of Health, after pouring a little oil of peppermint into an upper water-closet, most frequently recognise the familiar odour at this point. Sometimes there is not even a pretence of making a tight joint, the soil-pipe being merely inserted loosely into the drain. In other cases the joint, intended to be tight when made, through careless construction is not so; and again having been tight when made, it may have been injured since. Fig. 21 is from a sketch

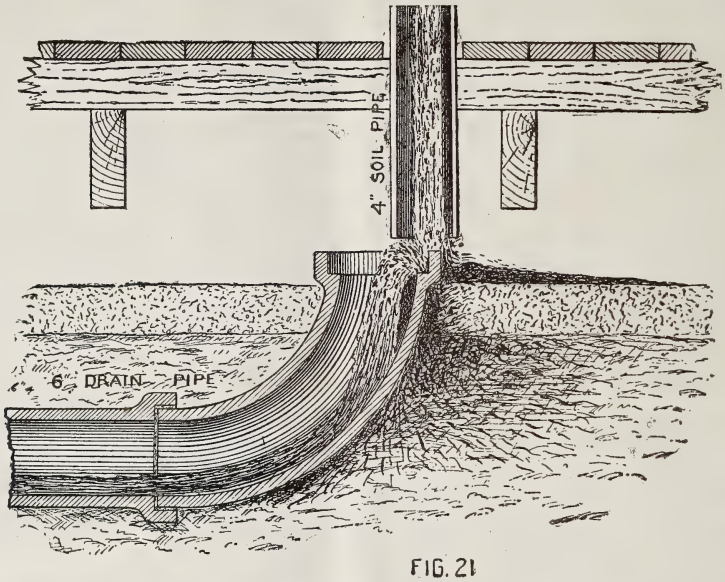


FIG. 21

made by Mr. Bradley of a case brought to his attention, existing in the house of a Boston physician. The drain may settle away from the pipe, or the pipe

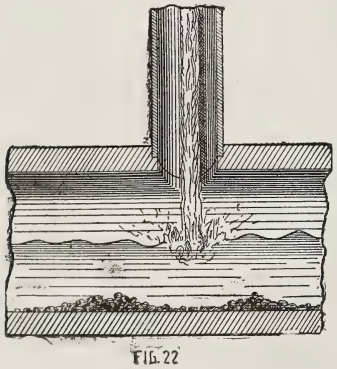


FIG. 22

may settle into the drain; an iron pipe by its expansion and contraction may break the joint between them. So liable is this place to disturbance, that when possible it

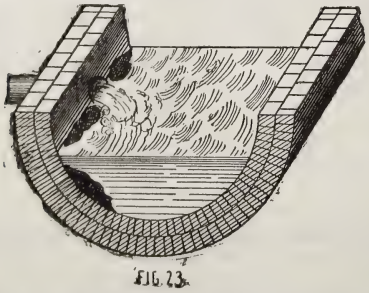


FIG. 23.

is well to build it so that it may be accessible to examination at any time when there is the least suspicion of wrong. Rats frequent drains, and dig into and out of them with surprising facility. An influx of rats into a house should be taken as strong presumptive evidence of a defect in the drain.

The mode of connecting a drain with the sewer affects more the efficiency of the latter than it does directly the sanitary condition of the house. But as, indirectly, the condition of the sewer as to cleanliness, efficiency, and liability to generate gases, affects, through the drain, every house connected with it, the proper junction

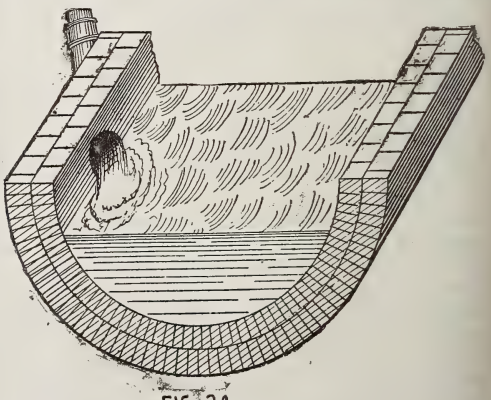


FIG. 24

of the drain and sewer deserves a degree of attention which, till quite recently, it has seldom received.

A drain should enter the sewer either by a curve tangential to the direction of flow in the sewer, or at an acute angle with that direction, so that the contents of the drain shall unite readily with that of the sewer, and the velocity of neither be much retarded. Nineteen out of twenty drains in Boston, built previous to 1876, enter the sewer at right angles. The effect of such an entrance from the top or side it is attempted to show in

the sketches (Figs. 22 and 23, p. 828), where the tendency to arrest the flow in both structures, and to cause eddies and deposits, is shown in a somewhat

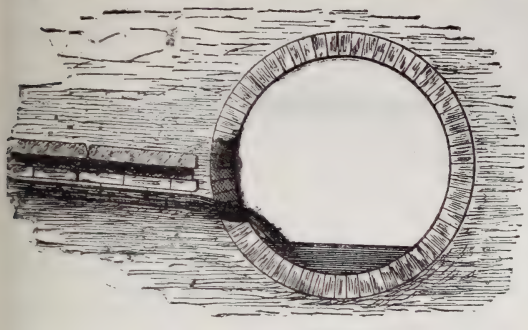


FIG. 25

exaggerated way. Fig. 24 (p. 828) shows the better result attained by connecting the drain at an acute angle.

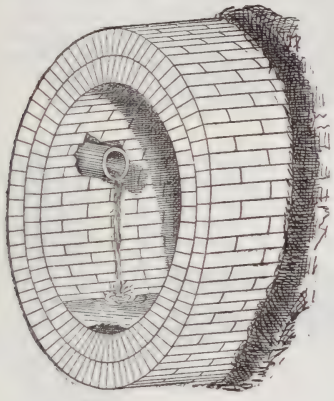


FIG. 26

pretty near to the sewer, and a hole broken into the latter. Of course water from both drain and sewer soaks into the ground, and occasionally the earth falls

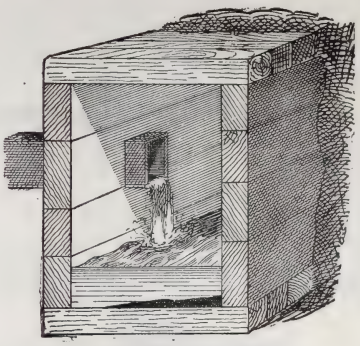
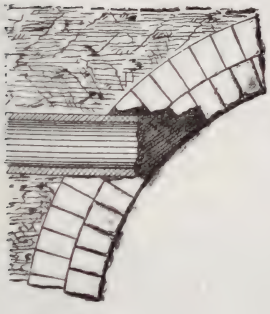


FIG. 27

into them. Often, as in Figs. 26 and 27, a hole, somewhat too large, is cut into the side of the sewer, and the pipe pushed through, and allowed to project, more or less, into the sewer. Fig. 28 shows the rough way in which pipes are often connected with the arch of a sewer.

The proper height in a sewer at which drains should be connected is about its ordinary flow-line. At this point the water from the drain mingles with that in the sewer with the least disturbance to both. In Boston, drains have commonly entered the sewers wherever they happen to run against them. As a general rule, they are too low (Fig. 29, p. 830); and water from the sewer backs into them, making a sluggish current. Their being too low might be expected from what was shown in connection with inclination of drains; and this results largely from an effort to drain cellars into a sewer higher than the cellar floors. Occasionally, a drain-layer, having found a sewer much lower than he expected, has dug vertically to it, broken a hole in the top, and around the hole erected a chimney with which to connect his drain (Fig. 30, p. 830). Often the hole into



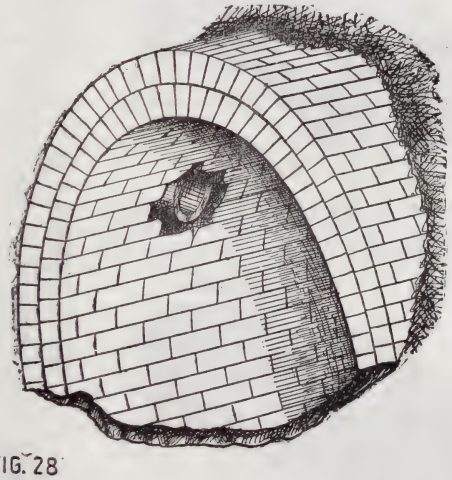


FIG. 28

It will probably be conceded that, whatever may be the mode of connection between drain and sewer, it should be made in a firm and workmanlike manner. In practice it has generally been very loosely and roughly made. Sometimes there is no connection at all, as shown in Fig. 25, where the drain is simply brought the sewer is much smaller than the drain which empties through it (Figs 31 and 32, p. 830). In such cases there are shoulders around the hole, on which solid matters accumulate.

The sketches that have been given exhibit what until very recently has been the method, or rather lack of

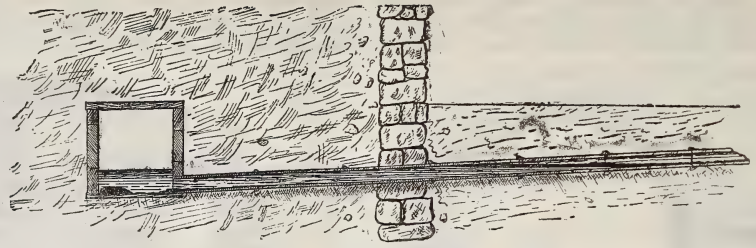


FIG. 29

method, of making connections with the sewers of Boston; and it is supposed that the manner of doing such work elsewhere in the State has been very similar.

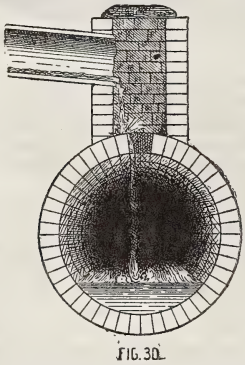


FIG. 30

In Boston there has been an improvement in this respect during the last three years. The superintendent of sewers, realising how much the efficiency of his charge

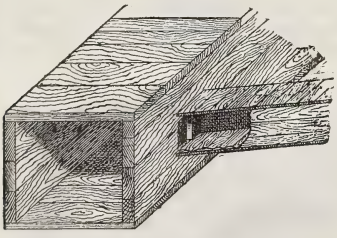


FIG. 31

was impaired by the way in which house-drains were frequently connected with the sewers, obtained, against considerable opposition, authority to require that any

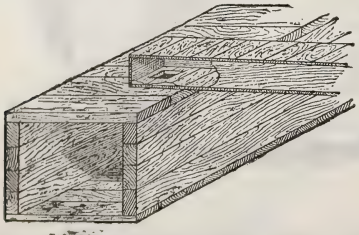


FIG. 32

future connections should be made under his inspection. His regulations require junctions to be made with slants and curves, as shown in Fig. 33; but, of the total number of existing drains, the proportion so connected is very small. Speaking generally, it may be said that almost all the drains in old Boston are defectively connected with the sewers they enter.

The material of which a drain is composed should be durable, both on account of true economy, and, what is more important, because, being generally out of sight, any decay or failure in it is not readily discoverable. For the same reason that portion of the drain within the house should never be put where it cannot be easily examined in case there be any suspicion of trouble. The materials most generally used for drains are brick, stone, slate, vitrified clay, cement, wood, and iron.

Bricks made of good clay, thoroughly burnt all the way through, are among the most enduring of building

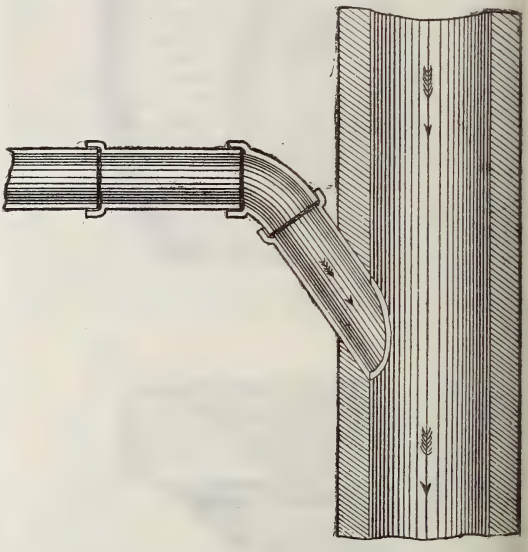


FIG. 33

materials. But all bricks are not so enduring. From some kinds of clay good bricks cannot be made. In every kiln of bricks there are some which are not thoroughly burnt. A soft brick will rot and disintegrate in water. Therefore, while, as regards durability, bricks may be said to be a perfectly suitable material for drains, the statement is only true provided great care is used in selecting them. Building stone and slate, often used for the tops and bottoms of drains, are generally durable (though there are instances of slate disintegrating in the course of years); but there are other reasons why their use is not to be commended.

What has been said about bricks applies to the clay drain-pipe (now so commonly used), to a degree not usually recognised. Too frequently one hears Akron pipe spoken of as though it possessed unvarying qualities. It should be remembered that such pipes

are burnt in a kiln very much as bricks are. Before burning they may be air-checked; like bricks, the pipes nearest the fire may be warped or fire cracked; those higher up may be less thoroughly burnt, corresponding to "light-coloured bricks." Others may be quite soft, and imperfectly glazed; or the glazing may scale off by "popping."

Slip-glazed pottery pipes are still more liable to defects. They are made of a different kind of clay, and, being burnt at a lower temperature, are usually more porous and less hard. The glazing, which is formed by dipping them before burning into a thin mixture of argillaceous earth, forms a skin over the pipe, which at times peels off under the action of frost, acids, or hard usage. While either kind of pipe, if well made, is durable enough, poor samples of each were occasionally noticed while constructing the intercepting sewer. It is important, that, in using them for house-drains, care should be exercised in their selection.

Without going into the vexed question of the comparative merits of clay and cement pipes, it is sufficient to say here of the latter, that while they can be, and often are, made so as to be very durable, yet cases where they have failed and disintegrated are frequently reported; and it is extremely difficult to judge from their appearance whether they are good or not. In resisting the acids or alkalies, they have been proved far inferior to well-burnt bricks or clay.

It is not easy to shape wood into the proper form for a drain. If it is always kept wet, as in the bottom of a drain constantly in use, it will last an indefinite time. Where it is alternately wet and dry, as in the sides or top of a drain, it is sure to decay sooner or later. Of those seen last year the report concerning many is, "rotten," "could not be held in place," "fell to pieces when handled," &c. The state of one such drain observed by the writer, in which the cover had partially rotted away, and earth fallen in, is given in Fig. 34.

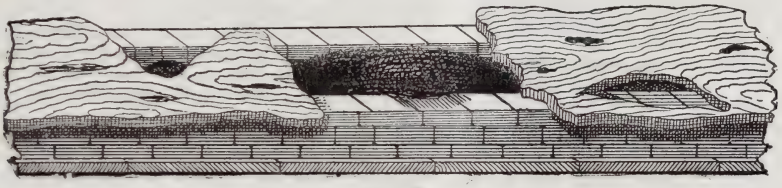


FIG. 34

Unless there are exceptional conditions, the use of wood for house-drains must be condemned on account of its liability to decay, as well as for other reasons.

The use of iron as a material for the construction of house-drains is of too recent date to permit of an absolute statement as to its durability. Thus far there seems little reason to doubt that it is suitable in this respect; and its many other merits will probably lead to its more extended use for this purpose.

Sanitary science, as it now exists, is of recent origin. Until within twenty years the arrangement and construction of sewers and drains were committed to mechanics and labourers, and were considered beneath the attention of educated men. Interest in the subject was first excited through the discovery by the medical profession, that a large class of diseases (thereafter called filth diseases) was induced by the presence of gases arising from defective drainage.

To investigate and cure the inefficient methods and appliances which caused these gases, lay within the province of the engineer; and hence sanitary engineering and sanitary engineers came into existence. These latter devoted themselves with ardour to unearthing evils, and devising remedies for them. Like new brooms, they attempted to sweep clean, and to purify at once the Augean stables they had discovered. But, like all reformers, they were sometimes carried away by their discoveries and theories; so that occasionally public opinion has re-acted against an exaggerated presentment of the evils of bad drainage. People have replied, "Nonsense! things connot be in such a desperate condition, or the human race would have died out. Our fathers lived comfortably to a good old age without bothering their heads about drains, ventilators, or traps; and we are willing to take our chances."

It might be answered that our fathers did not have our intricate apparatus for drainage to bother themselves about. Neither did they put on double windows, and ventilate their houses through their cellars, nor connect their drains with their sleeping-rooms, as we do. The writer has no wish to be an alarmist. The risk from sewer-gas is probably not so great as many suppose: it is a slight risk, but a slight risk of a terrible danger. If a man thinks there is no need of insuring his house, because his father lived in it for fifty years without a conflagration, he has a right to his opinion. What has been given in this paper, beside a few general principles, is a simple statement of what exists as seen by the writer and others. The question of plumbing has not been noticed, because the writer is not especially qualified to discuss it. He merely speaks whereof he knows; and the evidence is submitted without argument, for the consideration of those interested.

Should any one, admitting the evil, ask concerning a remedy, the answer is twofold. For the defective drainage which already exists, there can probably be no immediate radical relief; it can only come as people learn to appreciate the danger of sickness and the value of health. When householders become sufficiently interested to wish to know where and what their drains are, and to make a few investigations with bottles of peppermint and otherwise, then will the better day be at hand.

As to what may be done to prevent an increase of bad work, a suggestion is offered. It is safe to assume that every man who builds a house for himself desires that its drainage shall be fairly efficient: unfortunately, it is not equally safe to assume that he will spend the time, thought, and money necessary to make it so. Now, since a defective house-drain may affect not only the owner of the house, and his family, and all who may thereafter reside there, but also the whole neighbourhood, would it infringe on personal liberty too much, to require that the house-drain, if no more, shall be built according to approved plans and under municipal inspection? Merely to require that before beginning such work a plan of it should be put on record would accomplish something. In drainage, to have some plan, even if a bad one, is better than none. It insures a little though beforehand, a knowledge of the height of the sewer, and an adaptation of the drainage to it.

In Frankfort-on-the-Maine, which has lately been sewered on the most perfect system and with the latest results of engineering skill, it was found impossible to realise the expected benefits unless some control was exercised over house-drainage. In that city, connection with the city-sewers is not compulsory; but if any one desires, as nearly all do, to drain into them, it is required that detailed plans in duplicate, showing everything to be done, shall be filed, one with the

Board of Works for its approval, and the other to be kept at the house. The whole work is done subject to its constant inspection of materials and workmanship.

In the Eighth Annual Report of the State Board of Health, January, 1874, pp. 130-132, are given the conditions under which buildings, &c., are allowed to be drained into the new sewerage system of Frankfort. The plans to be filed are referred to thus:—

"Whenever the drainage of any house, yard, &c., is projected, the owner of the property in question must, after having signed the requisite certificate, furnish to the department duplicate plans bearing the signature of the contractor, and containing a map of the locality on a scale of at least 1: 2500, a ground-plan of, at least, 1: 250, and a sketch of the main drain and branches with its orizontal plane on the same scale as the ground-plan, and its profile, at least 1: 125.

"The certificate and one of the duplicate plans are to be kept among the documents of the sewer department; the other plan must be always ready for inspection by the officers at the place for which it is designed.

"All plans presented must contain all the works projected; the exact position of sinks, gullies, traps, and other details; the direction of the superficial water-carriers; the position of the rain spouts, cisterns, privies, water-closets, cesspools, vaults, wells, pumps, and other arrangements for water supply; also the levels of the surface where the works are projected, including the grades of the latter, the depth of the cellar, the lowest levels of the ground, and, where possible, the depth of the foundations—all to be given by the standard grade."

This preparation of plans is the pivotal point about which centres the whole regulation of private drainage. Its effect is probably, that, as the owner and mechanic are unable to make the plans with the requisite nicety and accuracy, they are prepared by an engineer familiar with the proper designing of such structures. It will be noticed that this filing of plans is not to be a mere form, but that a duplicate is to be kept on the ground, to be constantly referred to in constructing the work.

The question of sewerage is forcing itself upon the attention of all our cities and towns. Boston has appropriated between three and four millions of dollars for a system of interception, whereby its sewers shall discharge freely at all times, and their contents be diverted from the vicinity of dwellings. It is the first most important step, and, as the tax-payers realise, costs dearly. If the full benefit of this improvement is ever to be realised, it will only be when the house-drains and common sewers are rendered equally efficient, and the fundamental condition of perfect sewerage—an uninterrupted removal of waste matter from the house to its final place of deposit—is attained.

TEMPERATURE OF TOWN WATER-SUPPLIES.*

By Baldwin Latham, M.Inst.C.E., F.G.S., F.M.S.

In a paper read last year before this Association, the author gave the results of a series of experiments, extending over a considerable period, of the temperature of town water-supplies, and referred to the influence of the temperature of town water upon public health.

In the communication referred to, it was shown that the temperature of water, as delivered through the water mains to the house of the consumer, was totally independent of the temperature of the water at its source, and that the temperature of the water-supply was governed, to a great extent, at all periods of the year, by the temperature of the ground, at the depth at which the water mains were laid.

It was further pointed out that the influence of temperature upon water-supplies had a very marked effect upon certain classes of disease, especially diarrhœa and cholera, and that it was not until the temperature of the water reached about 62° that these diseases became epidemic in a district.

In order that it may be shown that it is not the effect of increase in atmospheric temperature that is instrumental in the propagation of diarrhœa and cholera, but that these diseases are governed by the changes which take place in water when its temperature is increased, it may be pointed out that, in districts in which the source of water-supply is not liable to increase of temperature by reason of the arrangements adopted for its distribution, summer diarrhœa does not become epidemic. For example, we will take the three years, 1877, 1878, and 1879. Both the years 1877 and 1879 (especially the latter year) were years in which town water did not reach its most dangerous temperature, but in 1878 the town water-supplies arrived at a high and dangerous degree of temperature.

The water distributed under the system of constant supply at the author's house in Croydon, when drawn direct from the mains, had, in 1878, a maximum of 64·8°; and, in Westminster, the water supplied by the Chelsea Water Company reached a temperature of 68·4°; while water taken from a cistern in Croydon had a maximum temperature, in the same year, of 71·5°. In 1879, the highest temperature of the water in the cistern at Croydon, already referred to, was 67°; the highest temperature of the water, as delivered from the mains in Croydon, in 1877, was 61·7°, and, in 1879, 60·7°; whilst in Westminster, the highest temperature of the water, in 1879, was 64°.

The deaths from diarrhœa in Croydon in the three years, 1877-9, were as follows:—1877, ·48 per thousand living in the district; 1878, 1·00 per thousand living in the district; 1879, ·34 per thousand living in the district. In London the deaths from diarrhœa were:—1877, ·70 per thousand living in the district; 1878, 1·02 per thousand living in the district; 1879, ·52 per thousand living in the district.

If these death-rates are compared with the death-rates of districts in which the water is principally taken direct from wells, it will be seen that in these latter districts the death-rates are very much lower, as for example, in the districts of Mitcham and Merton, which are partly supplied with water from artesian wells (of an uniform temperature of about 54·6°), partly by surface wells, and partly by the Lambeth Water Company. These two districts have a population, at the present time, of about 11,000 persons. In 1877, the death-rate from diarrhœa was ·39 per thousand, in 1878, ·47 per thousand, and in 1879, ·46 per thousand. In Beddington, which is also principally supplied from local wells, in 1877 the death-rate from diarrhœa was ·20 per thousand, in 1878, ·49 per thousand, and in 1879, there were no deaths whatever from diarrhœa. In the three years, 1877 to 1879, in the districts of Mitcham and Merton, there were 14 deaths from diarrhœa recorded, of which 10 occurred in roads supplied with water by the Lambeth Water Company, and four in roads supplied with water from shallow and artesian wells.

In order to further show that the temperature of water has an influence on health, the author placed upon a map the whole of the deaths from diarrhœa which have occurred in Croydon during the 11 years, 1869 to 1879, inclusive. The water-supply of Croydon proper is taken from wells, the range in the temperature of the water of which has not exceeded 1·15°, its highest recently observed temperature being 51·9°, on the 19th June, 1880, and the lowest temperatnre, 50·75°, on the 15th December, 1878. The water, after leaving the wells at Croydon Water Works, is pumped to a summit reservoir, from which it is distributed to the town. In order to raise the temperature of the water,

* Paper read before the British Association, Section G, Swansea, 1880.

it is necessary for it to flow a certain distance through the distributing mains before its temperature becomes affected. It is a significant fact that, in the districts within a mile of the reservoir in which the water is always at its coldest temperature in summer, during the whole period of 11 years, not a single death from diarrhœa has taken place in the neighbourhood of the leading mains, but the distribution of the deaths occurs in the most remote and lowest portions of the district, or those which are naturally subject to the greatest changes in the range of temperature of the water-supply.

The incidence of the deaths from diarrhœa in London and neighbourhood also shows that this disease is mainly due to the increase in the temperature of water-supply, and not to atmospheric temperature, as in all those districts supplied from the River Thames the water naturally gets to its highest temperature at an earlier period than it does in those districts supplied from wells, as in the Kent Water Company's district, where the temperature of the water at its source is pretty uniform throughout the year, and in which the water is naturally colder in summer, at starting through the mains, than is the case with the river water. An examination of the mortality tables of London shows that, while the general mortality from diarrhœa in districts supplied by the Kent Water Company and the River Water Companies is practically identical, the disease always first manifests itself in the districts taking water from the Thames. For example, in 1878, diarrhœa may be said to have been epidemic in Lambeth, supplied by river water, in the week ending 29th June, and got to its highest pitch in the week ending 27th July, whereas in Greenwich, supplied with the Kent water, this disease did not become epidemic until the week ending the 17th July, and got to its highest pitch in the week ending the 3rd August, showing the incidence of this disease to be later in the Kent Water Company's district than in the district supplied from the River Thames, the reason being that, as the water of the Kent Company is colder at its source than the Thames water, naturally it requires the ground to be raised to a higher temperature before the water reaches a dangerous point, and therefore the incidence of the disease falls later in the Kent district than in the district supplied from the River Thames. The development of the disease, in these districts, is also conformable to water being the cause, and not general atmospheric increase in temperature, for if the cause were due to atmospheric influences, which are general, the incidence of the disease should have fallen at the same period in each district, but as the incidence is strictly conformable to increase in temperature of the respective water-supplies, and does not conform with atmospheric causes, the inference to be drawn is that summer diarrhœa is governed by the influence of the temperature of our water-supplies, as invariably the disease becomes epidemic when the water, whatever be its source of supply, reaches a temperature of about 62·0°.

Having now shown that water may be affected for good or evil by reason of its temperature, and having also shown in a former paper that the earth has enormous powers of influencing the temperature of water-supplies, the author desires to point out a mode by which the temperature of the earth may be made use of, in order to give water a nearly uniform temperature throughout the year, which, if brought into general operation, the author believes, will remove those dangerous conditions of town water-supplies, arising from an increase of temperature in the summer time, and also, possibly, from the extreme coldness of the water in winter periods, which affect public health.

The great changes of temperature in the earth occur within a few feet of the surface. The greatest range of temperature occurs at the surface, and as we pass downwards from the surface to a depth of from 30 to 35 feet, the temperature becomes nearly uniform throughout the year, and at the point of uniform temperature, the temperature is equal to the average yearly temperature of the place where the observations are made.

From a number of observations made by the author, at depths varying from 6 inches to 50 feet, it is shown that, at a depth of 20 feet, the coldest temperature is experienced in the middle of May, and the warmest temperature, at this depth, at the end of October. The range in temperature observed at this depth is 5° in Croydon. At 25 feet in depth, the coldest period occurs at the beginning of July, and the warmest period in the winter, the range in temperature being a little over 1°. At a depth of 30 feet, the coldest temperature occurs in July. If an apparatus similar to that which has been invented and patented by Professor J. T. Way and the author, is used for tempering the water, and which consists simply of a vertical tube driven or screwed into the ground to a depth of about 25 feet, the water or other liquid to be tempered being admitted at the top and withdrawn at the bottom of the tube, and special arrangements being adopted for the protection of the ascending pipe, the range of temperature in the water required for dietetic purposes need not exceed 3° throughout the year, when drawn from a 3-inch tube, at a rate not exceeding one gallon every half-hour. The range of temperature observed in cistern water at Croydon has been 38·7°; or on the 22nd July, 1878, it was 71·5°; and on the 20th January, 1880, it was 32·8° The town water-supply of Croydon (drawn direct from the mains), the temperature of which has been shown to be nearly uniform at its source in the wells, when distributed by a system of constant service, was shown to be 64·8° on the 22nd July, 1878, and 37·2° on the 28th January, 1880, giving a range of 27·6°.

In the tempering tube, when the conditions of the water-supply are at the worst, the underground temperature is favourable for modifying these dangerous conditions. The cold of winter only descends to the greater depth in the heat of summer, and the warmth of summer only descends to the greater depths in the winter time, so that the temperature of the cold water of winter is raised by the previous summer's heat, whilst the warm water of summer is cooled by the previous winter's cold temperature.

Experiments made at the author's house in July, 1880, show that if 10 gallons of water are drawn at any time within half-an-hour, the following results are obtained: —

1st Gallon.—Temperature of water going into tube, 68·4°; and the temperature of the water coming out was 50·4°.

2nd Gallon.—The temperature was reduced from 68·2° to 50·8°.

3rd Gallon.—The temperature was reduced from 68·2° to 51·7°.

4th Gallon.—The temperature was reduced from 68·0° to 52·4°.

5th Gallon.—The temperature was reduced from 68·0° to 53·3°.

6th Gallon.—The temperature was reduced from 68·0° to 54·2°.

7th Gallon.—The temperature was reduced from 68·0° to 55·0°.

8th Gallon.—The temperature was reduced from 68·0° to 55·8°.

9th Gallon.—The temperature was reduced from 68·0° to 56·4°.

10th Gallon.—The temperature was reduced from 67·9° to 57·2°.

These experiments have been repeated various times, and give precisely identical results. In the winter the water is raised in temperature, as for example, on the 3rd February, 1880, water going into the tube had a temperature of 34·8°, and coming out a temperature of 49·2°.

The advantage of the use of this apparatus consists in

the fact that it is entirely self-acting, and the whole of the water-supply necessary for dietetic purposes may be filtered, purified, and tempered, without any greater cost than now incurred, after the first cost of the apparatus, and without adding anything of a deleterious character to the water, as may be the case when ice is used, which has been shown, especially in America, to be a prolific cause of disease, when collected from impure sources. Moreover, the results secured by the tube are more than equal to those attained by the most bountiful use of ice, and further, it is doubtful if, by the use of ice in water already subject to influences that are deleterious to health, the time allowed before the water is consumed is sufficient to destroy its noxious properties. In the case of the patent tube, however, a mass of water is gradually undergoing the process of tempering, in a perfectly natural way, until it arrives at a temperature which is shown by experience to be most healthful.

MINERAL STATISTICS.

The *Times* gives an abstract of the mineral statistics for 1879, just issued by Mr. Robert Hunt, F.R.S., Keeper of Mining Records. The total value of the minerals produced last year was £55,733,967, about half a million less than in 1878. The production of 1878 was worth £2,000,000 less than that of 1877, and that year showed a small diminution as compared with 1876. The lowest point was, as we may pretty confidently anticipate, reached in 1879. The figures for 1880 will be expected to be the first of an ascending scale. Last year the output of coal amounted to 134,000,228 tons. The value of the coal was £43,902,879, and as 16,442,295 tons of coal, coke, and patent fuel worth £7,206,799 were sent abroad, the total kitchen and furnace bill for fuel in the United Kingdom was £39,696,080, a small sum, as it seems, when the extent is considered to which the national earnings depend upon a judicious expenditure of coal. The quantity of tons of coal raised was larger by 1,400,000 tons than in 1878, but the price remained low. The returns furnished by the principal coal-carrying companies, railways, and canals, disclose a considerable increase in 1879 in the carriage of coal to places at a distance from the pit's mouth. The movement within the country exceeded that of the previous year by 4,407,879 tons, the quantity carried along the coast by sea was 948,162 tons more than in 1878, the imports to foreign countries were 948,162 in excess of those before recorded, and the total increase in tons of coal carried was 6,344,049. The company which had the largest share in the increased traffic was the London and North-Western Railway, which conveyed 1,126,429 tons of coal more than in 1878. The low prices of coal would appear to have encouraged consumption and to have enabled industries comparatively at a distance from the coal pits to bear the cost of carriage. The quantity of iron ore won in 1879 was 14,379,735 tons, worth £4,962,434. In 1878 the amount was 15,726,370 tons, and the value, £5,609,507. The decrease in amount was thus 1,346,635 tons, in value, £647,073. From the ore raised, 5,995,330 tons of pig-iron were made, of the value of £14,988,342; and in the process 13,117,411 tons of coal were used. The 6,381,051 tons of pig-iron manufactured in 1878 used up in the process 14,112,305 tons of coal, and a progressive economy in the manufacture will be observed. To make one ton of pig-iron in 1878 required the expenditure of 44½ cwt. of coal; in 1879, a ton of pig-iron was made with 44 cwt. In 1871, 51 cwt. were necessary to turn the ore into one ton of pig. A decrease was experienced in the iron ore imported, and if the diminution was in any considerable degree due to the new methods of making steel from Cleveland ores, and to a consequently less demand for the rich ores of the Basque country, it is a matter of congratulation. The imports fell 88,366 tons, from 1,173,411 tons in 1878, to 1,085,045 tons in 1879. The decrease appears, however, to have been general. It extended to "burnt" ores, the name applied to the refuse of the cupreous pyrites after the copper is extracted; the production sank from 400,000 tons to 332,330 tons. The total amount of iron ore smelted in 1879 was 15,797,080 tons, which as compared with 17,297,781 tons in 1878 shows a loss of 1,502,701 tons.

The copper pyrites imported from Spain and Portugal are very rich in metals. Not only is a considerable quantity used in blast furnaces or puddling furnaces, but a considerable quantity of silver and a small quantity of gold have during the last ten years been extracted from the cupreous pyrites imported. During the year 1879 this production was—Silver, 193,004 oz.; gold, 659 oz., value £46,062 10s. The principal portion of the silver, as well as the whole of the gold, was obtained from copper liquors at various extraction works by Mr. Claudet's process; and a small quantity of silver was separated from copper precipitate by manufacturers of sulphate of copper. Tin ore was raised in 1879 to the amount of 14,665 tons, and the value of £568,608. From this was made 9,532 tons of tin, worth £689,163. The production of tin plate increased during the year owing to the large American demand. There were made 4,250,345 boxes, as against 4,058,000 in 1878—an increase of 192,345 boxes. The "box" is a series of iron* plates of varying sizes covered with tin, and a "box" contains 8 lb. or 10 lb. of tin. The increase in the trade in canned meats, fish, fruit, vegetables, &c., is one of the elements in maintaining the demand for tin; and it may be noted that this, the most ancient article of export from Great Britain, was the only metal which did not lose in average value last year. Of copper ore, 51,032 tons, of the value of £177,382, were produced during the 12 months, and 3,462 tons of copper were made from it, worth £222,507. It is almost needless to say that large quantities were also imported. 66,877 tons of lead ore were raised, with £688,740, and 51,635 tons of lead, to the value of £765,489, were made. In zinc, 22,199 tons were raised, of the value of £81,531; and 5,554 tons, worth £95,806), were made. About 28 tons of silver ore were raised, but the bulk of the native silver production was from lead, from which source 333,674 oz., worth £70,905, were produced. Other mineral products mentioned in the lists are nickel and cobalt ore (116 tons), wolfram (13 tons), uranium or pitch blende, bismuth, ochre and umber (3,973 tons, worth £3,436), arsenic (5,492 tons, worth £34,180), fluor-spar and dross (1,264 tons, worth £422), clays, including porcelain, potters' and fire-clay (2,878,489 tons, worth £717,143), salt (2,558,368 tons, worth £1,279,184), barytes (19,349 tons, worth £21,068), and jet (3 tons, worth £1,000). It is estimated that sundry minerals, including shales, gypsum, calc, spar, coprolites, and phosphates, to the amount of 525,950 tons, and of the average value of 10s. a ton, were also raised. The total value of the minerals produced in 1879 is set down as £55,733,967, and this is the value after the labour of bringing them to the surface has been undergone.

REVIVAL OF TRADE.

A paper on this subject was read by Mr. Stephen Bourne before Section F. (Economic Science and Statistics), of the British Association, at the recent meeting at Swansea. In the course of his remarks, and comparing 1878–9 with 1879-80, he said, out of £19·14 additional exports, £18·29 has resulted from increase in quantity, and £·85 in price;

* Steel plate is now, to a large extent, superseding iron plate for tinning. The steel made by Dr. Siemens's process is that generally employed at present.

whilst for the import £43·80 is resolvable into £30·71 for quantity, and £13·09 for price. This proves that the revival has failed to give us more remunerative prices for the goods we have sold, but greatly added to the cost of those we have purchased. The increased export trade has been principally in iron and cotton goods, the one being £8·44, one-third of the whole increase of £27·00, and the other £7·30, or one-fourth. Iron has greatly risen in price, but cottons have slightly, woollens considerably, fallen. Of imports, more than half the increase is in articles for food, and one-fourth in raw material for our textile manufacturers. Of wheat we have consumed £12·00 in value, of which £7 represent quantity and £5 price. Of cotton we have taken to the value of £10·50, being £7·25 for quantity and £3·25 for price. Another branch of the inquiry is as to the countries with which this trade has been carried on, amongst which British India and the United States figure prominently; and an analysis of the figures shows, in the first place, that great as has been the increase in our exportations, that of our import trade has been far greater, the excesses of one over the other being £27,000,000. Some portion of this will remain with us on payment for freights, commission, and profits; but there must be a large margin left to be met by remittances in bullion, the transfer of securities, or in deferred obligations. Secondly, that the revival has been much more to the advantage of those who have sold to us than to those who have sold our produce and manufacture; for a higher rate of payments for imports with stationary rates for exports cannot increase the prosperity of either the actual consumers or producers at home. It would seem that we have effected sales, because prices are low, and made purchases because of our necessities, although prices have been high. Thirdly, that the whole excess in the value of the exports is scarcely equivalent to the entire cost of the food we have imported or consumed — and, unless we suppose stocks for future sale to be accumulating, there would seem nothing left to recompense capital for its employment or accumulation of wealth. Bad harvests have forced us to buy from others, especially the United States of America, who thus have profits to expend, and, looking to permanent extension, have purchased our manufactures at depressed prices. Good harvests at home, especially if abroad as well, may reverse this. The whole course of trade shows how, when one disturbing element comes, it is counteracted by the restorative power of some other. It also furnishes us with a most convincing argument in favour of the most unrestricted exchange of all commodities; both those which are absolutely necessary to our existence and of essential importance to our brethren in America. There is too much danger at present of being led into wild speculation, such as produced the fictitious prosperity of 1871-3, and culminated in the depression of more recent years. The judicious transferrence of capital and labour to other portions of our Empire, together with great thrift at home—individual, family, and national—are the true sources on which to rely for the maintenance or restoration of our manufacturing and commercial supremacy. All the above figures are in millions of money, to two decimals.

A NOVEL DOMESTIC MOTOR.

An American paper describes a caloric engine, intended for use as a domestic motor, the invention of Captain John Ericsson. The principle upon which it is founded is that of the alternate expansion and contraction of a given volume of air confined in a cylinder, and subjected to rapid alternations of high and low temperature. The cylinder, cast in a single piece, is mounted on a solid stand, in a vertical position. The bottom of the cylinder receives the heat, either from a small fire of coals or from several gas jets (three five-foot burners answer the purpose), where these are available. The upper third of the cylinder is provided with a water-jacket for cooling the expanded and heated air. The top of the cylinder is open. Into this cylinder is fitted a piston, whose stroke is confined to the space surrounded by the above-named water-jacket. There is also provided a solid plunger, of slightly smaller diameter than that of the cylinder, which is operated from a rod which passes through the piston and its rod. The mechanism by which the relative motions of the piston and the plunger are controlled, consists of a beam, to which the piston-rod is attached by means of suitable links, and which converts the motion of the beam into circular motion by means of a connecting-rod and crank, connected with a balance-wheel. The plunger is operated by a bell-crank and link from the connecting-rod. Its motion is the reverse of that of the piston: as this rises, the plunger falls, and *vice versâ*. Its function is simply that of displacing the confined air-body from direct contact with the heated bottom of the cylinder during each stroke. A feed-pump operated from the end of the beam supplies the water-jacket with a regular supply of cold water.

The confined air in the cylinder, being heated from the gas or coal flame, expands and forces the piston up suddenly to the top of the cylinder. As this occurs, the heated air is exposed to the continually increasing cooling surface of the jacket, and at the same time the solid plunger, actuated in the direction opposite to the piston, has descended and interposes itself between the air and the source of heat. In consequence, the air is cooled by the water-jacket, and contracts as quickly as it had previously expanded. The piston, which is exposed on the whole of its upper surface to the atmosphere, is forced down by atmospheric pressure, thus making one complete revolution of the crank and wheel. The lowest point reached by the piston is about one-third the distance from the top of the cylinder, where the water-jacket terminates, so that it is cushioned on the confined air. The descent of the piston is accompanied by the rise of the plunger; this displaces the air and exposes it again to the source of heat; it expands, forcing the piston up, and repeating the operation we have just described indefinitely. This apparatus, therefore, has no valves or air-pump, but uses a confined body of air over and over again. It occupies a floor-space of about 24 by 30 in., and is about 4 ft. high; having a 6 in. cylinder. It is stated that with a consumption of "a scuttle of coal" per day, or 15 cubic feet of gas per hour, it will pump 200 gallons of water per hour to the height of 50 ft.

ON THE PROPER FORM OF LIGHTNING CONDUCTORS.*

By William Henry Preece.

A lightning conductor, erected for the protection of a building, consists of a ribbon, rod, chain, rope, or other mass of metal attached to the highest point of the structure, and descending to the earth. What shall be the form of this conductor? has been a vexed question from the days of Franklin to the present. Shall it be dependent on extent of surface or on sectional area? In other words, does the transference of electricity when the potentials are so high as to cause lightning discharges, obey the law of Ohm, or is this law modified by the presence of some fresh condition? Snow Harris was a very warm candidate of the surface form. He used flat ribbons for his ships, and tubes for his buildings. Henry, of Washington, believed in the efficacy of surface. According to him, frictional electricity passes at the surface, galvanic electricity through the

* Paper read before Section A (Mathematical and Physical Science) of the British Association, Aug. 27, 1880.

mass.* M. Melsens is found on the same side, and Guillemin, of Paris, led many French electricians to favour the same view.

On the other hand, Faraday almost angrily espoused the opposite side. "As respects electrical conduction," said he, "no advantage is gained by expanding the rod horizontally into a strap or tube. Surface does nothing; the solid section is the essential element."

The advocates of the solid and cylindrical form argue that the lightning conductor is simply a path by which electricity is transferred from a point of high potential (an electric cloud) to a point of lower potential (the earth), and that its efficacy depends solely upon its resistance. It obeys the law of Ohm, and its efficacy is, therefore, for the same material dependent on its mass and sectional area.

The advocates of surface argue that, as in all cases of static charge, electricity exists only on the surface, so when electricity of "high tension" is conducted away, it is the surface that plays the prime part, and, therefore, the greater the surface, the easier the path to the discharge. Again, they say when a cylindrical conductor conveys a charge of electricity, it is raised to a "high tension," and is rendered capable of doing mischief; but with the same charge, the greater the surface, the less the density on the surface, and, therefore, the greater the safety. In other words, with a given quantity of electricity, the greater the surface, the less the potential. Moreover, they urge, since, according to Guillemin, currents of electricity flowing in the same direction retard each other with a power varying with the distance separating them, and since a rod may be considered as a bundle of smaller but parallel rods, so a current of electricity may be considered as being made up of many parallel currents, each retarding the other. Hence, a ribbon will conduct better than a rod, because the currents are spread further apart, and retard each other less. These arguments have led to the employment of unsightly ribbons and expensive tubes, which have considerably interfered with the establishment of this very necessary element of safety to buildings.

The arguments in favour of the surface form are, in the opinion of the author, deductions from exploded theories, from imperfect experiments, or from erroneous interpretations of well-ascertained facts. No direct experiments have ever been made to solve the question, as far as the author knows. Quantities of electricity, that is, static discharges from condensers, are in incessant use for telegraphic purposes, and are found to follow exactly Ohm's law, even with the most delicate apparatus. The knowledge of the flow of electricity through conductors, of the retarding influence of electrostatic capacity upon this flow, and of the distribution of charge, has become so much greater of late years through the great extension of submarine telegraphy and the labours of Sir William Thomson, Clerk Maxwell, and others, that I question if any English electrician would now be found to argue in favour of the surface form. Nevertheless, ribbons and tubes still continue to be used, and it appeared very desirable to settle the question experimentally. I determined to try to do so.

First Experiments, June 28, 1880.

Dr. Warren de la Rue, who is always ready to place his splendidly equipped laboratory at the service of science, not only allowed me to use his enormous battery and his various appliances, but aided me by his advice, and assisted me in conducting the experiments.

Copper conductors, 30 feet long, of precisely the same mass, (*a*) drawn into a solid cylinder, (*b*) made into a thin tube, and (*c*) rolled into a thin ribbon, were first of all obtained. The source of electricity was 3,240 chloride of silver cells. The charge was accumulated in a condenser of a capacity of 42·8 microfarads. It was discharged through platinum wire of ·0125 diameter, of different lengths. The sudden discharge of such a large quantity of electricity as that contained by 42·8 mf. raised to a potential of 3,317* volts is very difficult to measure. It partakes very much of the character of lightning. In fact, the difference of potential per unit length of air is probably greater than that of ordinary lightning itself. It completely deflagrates 2½ inches of the platinum wire, but by increasing the length of the wire, it could be made to reproduce all the different phases of heat, which are indicated by the various shades of red, until we reach white heat, fusion, and deflagration. Hence, the character of the deflagration, which is faithfully recorded on a white card, to which the wire is attached, by its scattered particles, is a fairly approximate measure of the charge that has passed, while the length of wire raised to a dull red heat is a better one, for any variation in the strength of the current within moderate limits is faithfully recorded by the change of colour.

Experiment 1.—Similar charges were passed through the ribbon, tube, and wire, and in each case 2½ inches of wire were deflagrated. No difference whatever could be detected in the character of the deflagration.

Experiment 2.—Ten inches of wire were taken, and similar charges passed through. In each case the wire was raised to very bright redness, bordering on the fusing point, and in two cases the wire broke. In each case the wire knuckled up into wrinkles, and gave evidence of powerful mechanical disturbance. The same wire was not used a second time. No difference could be detected in the effect through the different conductors.

Experiment 3.—Silver wire of the same diameter and length was used, and similar charges transmitted through it. Redness was barely visible, but the behaviour of the wire was similar in each case.

The conclusion unhesitatingly arrived at was that change of form produced no difference whatever in the character of the discharge, and that it depended simply on mass.

Second Experiments, July 19, 1880.

As it might be urged that the length of conductor tested was so short, and its resistance so small that considerable variations might occur, and yet be invisible, similar lengths (30 feet) of lead—a very bad conductor, its resistance being 12 times that of copper—were obtained, drawn as a wire, made as a tube, and rolled as a ribbon, each being of similar weight.

Experiment 4.—Charges from the same condenser, 42·8 mf., but with 3,280 cells, were passed through, and the discharges observed on 6 inches of platinum wire, 0·0125 inches diameter, which, in each case, was heated to bright redness. No variation whatever could be detected, whether the wire, the tube, or the ribbon were used.

Experiment 5.—In order to form some idea as to how closely we could estimate any variation in the character of the discharge, we used a long piece of platinum wire, and adjusted the lengths until we obtained just visible redness; then a diminution of 10 per cent. (3 feet) produced a marked change to dull redness, and further excisions raised the temperature to brighter and still brighter red.

The conclusion arrived at was that any change in resistance of 5 per cent. would have been clearly and easily discernible.

It therefore appears proved that the discharges of electricity of high potentials obey the law of Ohm, and are not affected by change of form. Hence, extent of surface does not favour lightning discharges. No more efficient lightning conductor than a cylindrical rod or a wire rope can therefore be devised.

* *Telegraphic Journal*, October 15th, 1877.

* The electro-motive force of the chloride of the silver cell is 10·3 volt.

COLOUR-BLINDNESS IN THE UNITED STATES.

This subject is attracting much attention in the United States, and Dr. Joy Jeffries' work, and reports upon it (see *Journal*, vol. xxviii, pp. 17 and 781), have caused the Government to take action in the matter. By the direction of the Secretary of State for War, it it was announced in August, 1879, that all accepted recruits would, in future, be examined at the principal recruiting depôts for colour-blindness, by the medical officers on duty. Previously to this, medical officers of the Marine Hospital Service were directed to examine, free of expense, any seamen owners of vessels presented to them. Such examinations were not compulsory; but, lately, compulsory examination of the visional power and colour perception of pilots has been ordered by the Treasury Department. During the past year, examinations of all sailors entering the United States Navy have been carried out. The cadets entering and leaving the United States Naval Academy, at Annapolis, are also tested, as part of their physical examination, by the inspecting Medical Board. The Boston and Hingham Steamboat Company is the only steamboat company which requires a thorough examination and certificate, by a medical expert, of the visional power and colour perception of all its officers and crew, who are called upon to distinguish marks, buoys, and coloured signals, and this is in addition to the required examination of their pilots by the medical officer of the Marine Hospital Service.

A petition from ophthalmic surgeons and other scientific men, praying for a general law of control in the navy and merchant service, was presented to Congress in January of the present year. This petition was referred to the Naval Committee, who reported as follows:—

The petitioners are among the best and most scientific men in the country. They take a very deep interest in the subject; and we think they are fully justified in presenting it to Congress, and urging action upon it. Its action cannot, in the opinion of the committee, be over-estimated. Vast numbers of human lives, and a commerce of immense value, depend for their safety upon the perfect eyesight of the men in charge of vessels and railroad trains. Persons who cannot distinguish perfectly the colours of lights, flags, signals, and buoys, or are liable to mistake them, or who, from a want of acuteness of vision, cannot perfectly observe the forms of objects at ordinary distances, ought not to be placed in positions of responsibility on ships at sea. A perfect watch at sea requires perfect eyesight. The subject is comparatively new, but not the less important; and, perhaps, for the reason that it is new and important, it should have the more careful attention.

Throughout the civilised world there has been, for the last few years, great attention drawn to defective vision and colour-blindness among sea-going men, as well as railroad *employés*.

Reliable statistics from the best medical experts in Europe and America, have proved the existence of colour-blindness in about 4 per cent. of men, while in women this peculiar defect is very rare. Colour-blindness exists as red or green blindness, one involving the other. Violet or blue-yellow blindness also exists, though more rarely.

Red and green being the colours which all maritime nations have agreed to show on the port and starboard sides of vessels at night, and red buoys, red storm signals and lighthouse lights being used, or necessity requires, on the part of those navigating vessels, a normal or perfect perception of colours, and this, of course, in addition to good eyesight for form, or normal visual power.

In proportion as the person is colour-blind, in that proportion will the red and green lights or signals be indistinguishable from each other, and the person be uncertain which he sees. This defect exists in all degrees of severity, the lightest forms often being the most dangerous, since, if the person who can see a strong red light at a certain distance, while the pale green light cannot be distinguished from the mast-head light, he may be deceived as to his surroundings, and fall into fatal errors which he cannot account for or excuse himself for, but which may be wholly attributable to colour-blindness, of the existence of which he is himself wholly unconscious. Just such a case has been reported.

Colour-blindness is very hereditary. When congenital it is incurable, and cannot be palliated by any practical methods. It is also said to produced by injury, disease, and poisoning by alcohol and tobacco. All these conditions are now recognised in regulations for its control on land and sea.

Till Prof. Holmgren, of Sweden, introduced his method of examination, medical experts had no accurate and quickly-applied means of testing for colour-blindness. This is largely the reason why it and also defective visual power have been overlooked in the past.

Now that attention has been so generally called to these sources of danger on land and sea, European Governments, and railroad corporations have enacted laws, and adopted rules of control. In this country, only one State (Connecticut) has passed the requisite laws. Some railroad corporations have acted, but, as was also first done in Europe, in an uncertain manner, from lack of recognising the necessity of medical experts to carry out the examination in a thorough and systematic manner.

The maritime nations of Europe have introduced these tests into their navies, and some of them into the merchant marine. Our Government has recognised the importance of the subject, as shown by the action of the three departments—Army, Navy, and Marine Hospital Service. In the last, it is made compulsory with pilots, but not with seamen.

While maritime powers have sought to eliminate the danger from colour-blindness by requiring examinations, all have not directed such methods to be used as would render the elimination certain. Moreover, all are not agreed as to the requisite amount of colour perception necessary to render a look-out perfectly safe for the vessel the look-out is on, as well as for the one approaching. There is also no definite standard of visual power acknowledged as necessary in the navigation of vessels. Mutual intercourse, and the comparison of the results of different tests, would enable the maritime nations taking part in it to avail themselves of each other's experience, and readily lead to the adoption of the best methods of examinations and the requisite standard of requirements.

Dr. Jeffries, in his "Manual" above-mentioned, says:—"The test for colour-blindness now being so simple as to be readily carried out by the surgeons attached to vessels, especially naval medical officers, there can be no great difficulty in having an international Commission meet and frame the laws or regulations which shall govern all the navies and merchant marines of the great maritime nations at least. It would then be as readily recognised that every officer and man must be able perfectly to distinguish the red and green lights as to know where they belong and what they mean." This author's experience is based on the examination of over 30,000 individuals, and corresponds with that of all the scientific observers. The final conclusion in his Manual is: "An international Commission should be called to establish rules for the control of colour-blindness on the sea, and the carrying out the same examinations among pilots, masters and crews of steamers and sailing vessels in the navies and merchant marine."

It will avail but little if, of two vessels of different nations meeting, but one of them has no colour-blindness on the look-out. An international Commission

would, from the weight of its authority, force examinations, even among those nations not participating in it, as well as settle standards, methods, and requirements.

The committee recommends the adoption of the joint resolution herewith reported, as a first step toward the accomplishment of the object in view.

Whereas, it is important that definite and uniform standards of examination for colour-blindness and tests for visual acuteness in persons employed in the navy and the merchant marine should be established, which will be in harmony with such standards and tests established or to be established by other nations. Therefore—

Resolved, by the Senate and House of Representatives of the United States of America in Congress assembled, that the Secretary of State is hereby authorised to designate such officer or officers in the diplomatic or consular service of the United States, and the Secretary of the Navy is hereby authorised to detail such officer or officers of the Navy of the United States as may be deemed qualified for such service, to attend and represent the United States in any International Congress held to consider and act on said subject. And such officers so designated and detailed shall join in a report of the proceedings of such Congress and of the conclusions reached thereby, if any, to the President of the United States, to be by him laid before Congress, to the end that an international system of examinations and tests as aforesaid may be established by law.

This Bill will come up at the next session of Congress. Meanwhile, the attention of other maritime nations is being called to the whole question, and the usefulness of the proposed international Commission.

The difficulties pointed out in Dr. Jeffries' book have been experienced by the railroads. In Massachusetts, the only railroad that has had any of its *employés* tested by a medical expert is the Boston and Lowell, and the report to the manager, August 1879, shows the necessity of these examinations. There is, however, no law to prevent the continuance in office of those *employés* found defective. Many other railroads of the country have carried out or are carrying out examinations of their *employés*, but their reports are not at present accessible. The Railroad Commissioners of Connecticut have devoted much space to this subject in their report, January, 1880, and in consequence of their report the whole subject was referred to a committee, who reported a Bill to the Legislature, which passed both branches of the State Government, and was signed by the Governor. The title of the Bill is "An Act directing the examination of railroad *employés* for Colour-blindness and Visual Power."

The rights of the various parties interested are carefully considered, and the exact duties of examiners and officials defined. The rules and regulations emanating by law from the State Board of Health have just been made public. They concern directly many thousands of railroads *employés* in Connecticut, as all there have to be tested before October 1, 1880.

In reference to the general action taken by public bodies, the *Nation*, of January 15, 1880, observes:—"The subject offers the most striking recent instance of a strictly scientific inquiry that has suddenly been transformed into a serious question of every-day practice."

SCIENCE IN ELEMENTARY EDUCATION.

At the Sheffield (1879) meeting of the British Association, a committee was appointed in Section F (Economic Science and Statistics), for the purpose of considering whether it is important that her Majesty's Inspectors of Elementary Schools should be appointed with reference to their ability for examining the scientific specific subjects of the code, in addition to other matters. At the Swansea meeting just concluded, Dr. Gladstone brought up the report on this question. It was to the following effect:—

"1. It has come to their knowledge that the teaching of the scientific specific subjects is practically discouraged by the incapacity of many of her Majesty's inspectors to examine in them. 2. This incapacity is explained by the fact that the inspectors are not generally chosen so much for their fitness to judge of such educational work as on account of their high scholarship, or through political patronage. 3. In the opinion of this committee there might be an examining body for her Majesty's inspectors, composed of three of the most experienced of the present Senior Inspectors' Association, with a similar number of the science examiners of the Science and Art Department. The examination should be thrown open to elementary teachers, and the candidates might be tested in the practical work of examination in one of the central elementary schools in London. 4. The committee believe that the opening of the inspectorship to fully qualified elementary teachers would tend to raise the *esprit de corps* of the profession, and improve the character of both inspector and teacher. 5. The committee are further of opinion that while a University degree may be fitly regarded as a test of scholarship, it is not a test of the particular qualifications for an examiner, and therefore it is not sufficient in itself to guarantee the holder thereof as worthy the position of inspector. There appears to be no reason why academical honours should be made an indispensable condition of appointment. 6. The committee recommend that a memorial be presented to the Lords of the Committee of Privy Council on Education, embodying the above conclusions."

GENERAL NOTES.

Explosions in Coal Mines.—The *Athenæum* notes that the French Fire-Damp Commission, which was organised some years since, has just issued a long report, recording the causes of 420 accidents by explosions. Sixty-four projects were presented to them by private individuals, and some new instruments have been constructed. The influence of coal-dust upon explosions has not been satisfactorily determined, but a series of propositions have been transmitted to the French ministry, which will be laid before the Chamber next Session.

Colouring of Preserved Vegetables.—It is reported that M. Lecourt, a preserve manufacturer of Paris, and Professor Guillemare, of the Lycée of Rheims, have devised a new process for giving the required green colour to preserved vegetables without the use of salts of copper. From a report addressed to the Consultative Committee of Public Hygiene of France by MM. Wurtz, Gavarre, and Bussy, it appears that this new process consists in adding to the vegetables employed a surcharge of chlorophyll, so that after the inevitable loss caused by boiling at 120° C., they still retain sufficient to present the green colour of fresh vegetables. MM. Lecourt and Guillemare obtain the green colour thus utilised from table vegetables, especially spinach, which contains a great quantity that is easily extracted. By an appropriate manipulation they obtain this green matter in solution in water alkalised by soda. The vegetables being plunged in boiling water, previously acidulated by hydrochloric acid, a suitable quantity of the solution of chlorophyll is turned into the water. The vegetables are washed several times before being enclosed in the vessels in which they are to be submitted to the high temperature necessary for their conservation.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

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LECTURE II.—DELIVERED MONDAY, APRIL 12TH.

Floor, Wall, and Ceiling Decoration.

In my lecture this evening, I purpose to treat generally on floor, wall, and ceiling decoration, and to offer various suggestions for the treatment of the floor and wall surfaces; but as I am more especially adapting my remarks to town houses, it will be necessary to remember that as a rule—the light being practically obtained only from one end of a room, and this in the back rooms, generally more or less obstructed by surrounding buildings—it is desirable that the general tone of colouring and decoration should be bright and cheerful, so as to neutralise as much as possible the prevailing gloom. In new houses, there will be little or no difficulty in arranging for any kind of floor, wall, or ceiling decoration that you may wish to use, or think most suitable to the character of the house. In existing houses there are, of course, many difficulties to contend with, if you in any way wish materially to alter the design and character of your flooring, by the use of marble, mosaic, or tile paving, or to alter in any way the existing ceilings of the various rooms, except by mere flat decorative treatment of the original plaster work.

The cutting away of the generally bad plaster enrichments, so as to render the whole space fitting for the superimposing of more suitable decoration, in the way of designed canvas plaster ornamentation, or plaster or wood paneling, must necessarily be somewhat costly. Much may, however, be done, by careful and slight tinting in paint or distemper, and general arrangement of stencil decoration, to make the existing ceilings more artistic and in character with the decoration of the walls.

In most town houses the floors of the hall and inner hall are of stone, and any cutting away of this, for the purpose of laying over it any kind of marble or tile pavement, must necessarily be troublesome and costly. The stonework itself, if kept clean and white, will form a very good border for simple Persian or Indian rugs. These are generally cheerful in colour and pleasant to the feet, are readily taken up and shaken, and tend to make the usual dismal entrance of a town house look warm and comfortable.

An inexpensive way of adding to the artistic effect of the old stone paving is to incise in it one or two lines as a border, the lines being of unequal thickness, and then filled in with coloured cements, or narrow tile slips. The process adopted by Baron Triqueti, in the work executed by him at Windsor, for her Majesty the Queen, and called "Tarsia de Marbre," consisted of cutting or hatching numerous lines in the marble slab, and filling them in with coloured cements, somewhat after the manner of the well-known pavement in the Cathedral at Sienna; but the process is not one to be commended, and the result is, from an artistic point of view, when applied to figure decoration for wall surfaces, anything but satisfactory. I see no reason, however, why the inlaying of stone with coloured cements or marble or tile slips, should not be more generally adopted for the pavements of halls and conservatories. Another simple and inexpensive way of treating the old stone paving, is to form a large square or diagonal diaper pattern all over it, by means of slightly incised lines, and inserting at the junction of the lines small red or black tiles, so as to form a distinct pattern. All this kind of work can be done very inexpensively, and, to my mind, commends itself to those who are anxious to avoid the everlasting monotony of linoleum or oilcloth, which soon lose their brilliancy, and want renewing in a few years.

A more expensive way of improving the old stone paving is by cutting a space, say 12 inches wide, as a border all round, and filling it in with grey, red, and black marble slips, or with a pattern border of marble mosaic, or tile-work. All this kind of work can, of course, be amplified to any extent, but in any simple way, such as I have suggested, the existing stone floors can be made infinitely more pleasant and artistic.

Marble mosaic, and plain or encaustic tile paving, have of late years come largely into use, and it is not necessary to enlarge upon the excellence of either of these special ways of paving; but remember always that, with tiles, simple designs and masses of plain colours, red, grey, or buff, are to be preferred to elaborate patterns, which, as a rule, are anything but artistic, and too often utterly unsatisfactory. In tile pavements it is desirable, especially in the ordinary narrow hall of a London house, to have as broad a treatment of the spaces as possible, and to avoid altogether the all-over patterns which are published in most of the pattern books laid before the public; not only are these elaborate geometrical patterns unsatisfactory when laid, by destroying the breadth of surface, and seemingly diminishing the already too narrow space, but they are infinitely more expensive than plain red four or six inch tiles laid over the whole space, with a simple border of black or buff. A plain red tile pavement of this kind, is infinitely pleasanter, warmer, and more suitable for a London hall, than any of the elaborate patterns which are offered for the public choice, and repeated *ad nauseam* in oilcloth and linoleum.

In late years, there has been a very considerable revival in the work of marble mosaic for pave-

ments. Messrs. Burke and Co., and other manufacturers, have endeavoured to bring this eminently beautiful and artistic work into more general use, by economising, as much as possible, the cost of its production and laying; but this kind of pavement is necessarily costly in small spaces, varying from 50s. to 70s. a yard, but when laid, the result is most satisfactory. Messrs. Minton and Messrs. Maw make tesseræ of burnt earth, with which a somewhat cheaper pavement can be made.

In all this kind of work, it must be remembered that a considerable extra thickness is superimposed upon the existing stone base, and that this must be provided for, either by cutting away the stonework, or by splaying down the new coating to the floors of the rooms. The first procedure is expensive and unsatisfactory, as weakening the constructive flooring; but the splaying off in the door openings can be done so as to in nowise be inconvenient or objectionable, and the expense of cutting away the stonework is thus avoided. Of course, if the floors are of wood, all this expense is avoided by taking up the old flooring, and filling in between the joists with concrete or pugging, and so providing a solid level surface for the new flooring. In the limits of my present series of lectures, I can hardly enter into the question of the use of mosaic for general decoration, for naturally it hardly suggests itself as suitable for the covering of the internal walls of our houses, and the action of frost and moisture practically prevents its adoption, except when carefully protected, for external work; moreover, for all absolutely decorative purposes it must necessarily be costly, and its effect at short distances is generally unsatisfactory. Applied to the decoration of large monumental structures, mosaic has been used from the earliest civilised times, and the wondrous beauty of the ancient examples which still remain, in mural decoration and pavements, speak better than all words to its interest and durability.

Another and a cheaper way of paving, is by the use of what are called marble mosaic tiles; these tiles are made by pressing a number of marble chips into Portland cement, either without pattern —as "misciata" or in a pattern; the tiles, when dry, being polished. The effect is good and pleasing, the cost varies from 10s. per square yard, and if the tiles are used in single colours of red, grey, and black, an effective pavement can be obtained at a small cost. Inlaid cement work for floors ought to be much more encouraged, as cheap and durable.

I need hardly refer to the ordinary covering of a London hall by means of linoleum and oilcloth. I consider both objectionable, and to be avoided, as far as possible. Painted oilcloth soon becomes shabby by its pattern being worn through, and, as a rule, this pattern is only an imitation of tile or parquet work, bad in treatment, colouring, and design.

Until quite recently, it has been the fashion to cover the whole of the floors of our reception and bedrooms with drugget or carpet, which, as a rule, was never removed, except at the usual periods of spring and autumn cleaning; and it is hardly necessary, therefore, to object to the system as utterly opposed to all laws of health and cleanliness. Floors thus covered, as a matter of course, become the receptacles of dirt and dust, which no amount of brushing can get rid of, and this daily brushing serves only to raise a cloud of dirt and dust, which settles in part upon every object in the rooms, and in part returns to its original resting place. It is a matter of astonishment to me to find that there are still a large number of people who are content to keep this exceedingly bad arrangement of floor covering, and who object altogether to having a certain amount of plain floor space all round the sides of the room. In the first place, this covering of the whole surface is unhealthy; in the second place, it is dirty; and, in the third place, the cost of the carpet is infinitely more than the cost of painting or staining the edges of the rooms.

There are many ways of treating the floor surfaces of a room, either in part, or entirely, so as to avoid the necessity of carpeting the whole surface. The cheapest way is to paint, say a margin of two or three feet wide, all round the room, in four or five coats of dark colour, care being taken that the groundwork throughout is dark, so that scratches shall not show any light colour under, and that sufficient time is allowed for each succeeding coat to harden and dry. A square carpet or rug can then be pinned down over the centre space, which can be easily taken up once a week and shaken, and the borders can be washed or cleaned every day.

New floors can either be treated in this way, or stained and varnished, or wax polished. Many of the floors abroad are formed entirely in tiles, laid upon concrete filling in between the wood joists; but although clean and healthy, this kind of floor is somewhat cold and dismal, and, unless extremely well laid, the joints are too apt to form receptacles for dirt and dust.

A more expensive way of forming borders is by means of "Parquet." This consists of the fitting together, in narrow strips, of various hard woods, carefully grooved and tongued into a pattern; this work is, however, expensive, varying from 2s. 9d. per foot super., laid, and involves considerable labour and expense in cutting and altering the old floor, unless, of course, the whole surface be covered with parquet.

The general effect of this inlaid wood-work is more showy, but I am not prepared to say more artistic than plain painting. Messrs. Arrowsmith, and other well-known upholsterers, have for years laid themselves out for this kind of work in solid "parquet," which must not be confounded with the thin veneering glued down to a common deal backing, which, although practically cheaper, is inferior in quality. Messrs. Howard, of Berners-street, have patented what they call "carpet parquet." This is made, by machinery, of very thin strips of wood, which are first desiccated, then cut to the required form, arranged into a pattern, and secured by a canvas backing. The advantage of this is, that it can either be laid as a border or entirely over the room, without interfering with the old floor; and, if laid as a border, any ordinary carpet practically fills up the thickness, and the cost, ranging from 6d. to 1s. 6d. per foot super., is much in its favour. All parquet work is practically impervious to dust, and, therefore, naturally conduces to the healthiness of the room, as there are no open joints to collect dust, or what doctors call germ seeds of disease.

It would, I take it, be impossible, in this dingy city, to apply the teaching of the old northern

Italian artists—who covered with distemper decoration the exteriors of their houses—to London houses of the present day; but we might surely take from their work some few hints for the decorative treatment in paint, of plain plaster walls, and so improve the unutterably inartistic and miserable appearance of our London streets and squares.

We cannot have Italian climate or Italian brilliancy of sky or sunlight, but surely this is all the more reason why we should endeavour to give some colour to the dingy streets, made more dingy by the smoke and other impurities of London atmosphere and London fogs. Even the stucco palaces of Belgravia and Tyburnia might be made fairly pleasant objects to look at, if relieved with coloured decoration, in some such way as the houses in the Piazza delle Erbe at Verona, from their dreary monotony of imitation stone colouring, and sickly commonplaceness of Portland cement.

We may almost be grateful to those who first broke away from the ordinary colour, and painted the exteriors of their houses red or blue, and for the attempt made by Messrs. Jackson and Graham to introduce external coloured decoration in the new Continental Hotel, in Waterloo-place.

I do not see why we should have all our houses dingy as well as bad in architectural design; the speculative builder has provided us with all that is filthy and objectionable in the way of design; we, if we like, can do something, without any great outlay of money, to neutralise this, by judicious use of colour in some of the monotonous lines of cornices and wall faces, instead of always adhering to the dreariness and dismal commonplaceness of grey and stone colour.

The palaces of Venice, and the cinque-cento churches throughout Italy, show how marvellously the use of marble, even in small panels, brightens up and relieves the surface of a flat dull wall. Marble has been universally admitted to be the best and most appropriate for surface decoration, and a few *plaques* inserted as panels in our street fronts would do something to lighten up and break the present dulness, at a comparatively small outlay.

Architects get the credit of being the authors of innumerable bad works, but we are not responsible for the vulgar, tasteless erections of the last 20 years, which make up the streets and squares of the greater part of fashionable, modern London. No wonder that London is the dingiest, the dreariest, and the ugliest city in the world; no wonder that all artistic feeling is crushed, when we see the endless rows of cement-covered houses, of hideous outline and common-place design, left grey, in all the shabbiness of Portland cement, or blossoming out in triennial springtides of fresh paint, which whitewashes for a while the tasteless vulgarity of our street façades.

It would seem that the architect and the painter are not in accord—that there is a want of that proper sympathy and art brotherhood, which, in older days, made men think nothing too insignificant to work upon—the painting of a great decorative picture, the figure decoration of a noble hall, the painting of arabesques on walls, or the tinting and colouring of outside plaster work. Why should this want of sympathy exist?

I am quite certain that amongst all good architects there is a strong desire to bring into their work the work of the painter, and to associate with their building, in goodly and pleasant fellowships, the work of the sculptor and the painter.

I see no reason why the skill and thought of the architect and decorator should not be employed, in making the general run of commonplace street architecture pleasanter to look at, by means of coloured decoration, lightly, simply, and economically treated, or by the use of glazed terra-cotta in a variety of colours.

Why cannot we learn a lesson from the treatment of some of the external façades in the street of nations in the late Paris Exhibition, and adapt majolica ware and *faïence* to the external decoration of our houses?

The money spent on a piece of *bric-à-brac* or an ordinary water-colour, if judiciously laid out, would provide for the decoration, in good glazed terra-cotta or tile-work, of the entrance door of a house; and, with a little thought and a moderate outlay, the miserable skeletons of London street houses might be vivified and brought into at least some semblance of pleasant life and colour.

Fresco decoration in distemper is out of the question; but painted pottery, terra-cotta, mosaic, and even iron enamelling may, rightly treated, be well fitted to give colour and even beauty to our London streets, and such work would not suffer by smoke or atmospheric influences, would be freshened and cleaned by each shower of rain, and made brighter by each breath of wind.

Internally, there are naturally very many ways for the decorative treatment of the wall spaces; but, as I purpose in my future lectures to offer suggestions for the special treatment of the walls of various rooms, I shall at present confine my remarks generally to the materials which may be used. Chief, perhaps, amongst the various ways of covering the walls of rooms in the Elizabethan age, was by hangings of tapestry or arras. These, as a rule, were simply hung upon the walls, and where, as very frequently in earlier days, the walls were of brick or stone, not plastered, the heavy tapestry, hung to tenter hooks, at once hid the rough work under, gave warmth and comfort to the cold and cheerless walls, and was easily taken down and stowed away. Another way of covering the walls was with painted cloth, or canvas, painted in with various subjects, devices, and mottoes. The elaboration of this kind of hanging was taken up by the French, and more recently introduced into this country, in the way of straining damask, satin, silk, or other material over the wall surfaces either entirely covering the wall, or arranged in panels by mouldings. All this kind of work, however charming in itself, is to my mind essentially out of place in London rooms. Tapestry is gloomy, and holds dust, and silk and satin are too delicate to stand the smoke and dirt of town atmospheres. Anything that holds dust is essentially out of place on the walls of our rooms; and no matter how picturesque the general effect of good tapestry, it would be utterly out of place in the permanent decoration of the wall surfaces of our houses; but I see no reason why good pieces of old tapestry should not be strained and hung on the walls of the halls or staircases, as pictures or any other objects of art, so long as they are moveable, and easily shifted for cleaning purposes.

I confess my own views are that anything that by its surface collects and holds dust, is to be carefully avoided in all wall decoration in London houses, and for these reasons all flock papers, as well as those stamped in relief, are, as a rule, to be avoided, except for ceiling or frieze decoration. Some of the better class of double flock papers, for instance, such an one as the exquisite sun-flower pattern designed by Mr. Talbert, and made by Messrs. Jeffrey, are admirably adapted for a dining-room, when a high wood panelled dado is used, and the paper surface is limited; this paper is sufficiently decorative by itself, but is also admirably adapted by its tone of colouring for pictures or engravings.

The present French system of panelling the rooms with elaborate framework of intricate mouldings and carvings, and filling in the panels with silk or paper, is certainly not adapted for London rooms; the carvings and mouldings hold dirt, require constantly cleaning, and are extravagant and costly; nor do I think the effect in any way satisfactory, except in very large reception rooms.

Any system of panelling the general surfaces of walls of an ordinary London room will be found inconvenient and unsuitable for hanging pictures, and otherwise decorating the walls, as it necessarily requires everything to be equally arranged and fixed in the centres of the panels, or in the dividing spaces, and it seems absurd to hang a picture on a small scale in a panel of great size. In the great houses and halls, where large full-length ancestral portraits filled up nearly the whole space, the arrangement had fewer objections, more especially as it formed part of the general construction of the rooms, the great mantel being designed with it, the whole finished with skilfully designed cornices and ceilings, with flat mouldings worked into elaborate or simple panelling.

Of course, all this, done in large rooms, is expensive, and, unless the general furnishing be on an equal scale, incongruous and absurd.

Embossed leather was largely used in the Elizabethan age for wall hanging, but this is exceedingly difficult and costly to obtain; where used, it may be formed into a high dado, with a wood-rail moulding over, or divided into small dado panels, where the ornament or pattern will admit of it. The papers stamped after the manner of leather, by Messrs. Jeffrey, are exceedingly good in design, and fairly inexpensive.

Mr. Walton, of Sunbury, has invented a new kind of material for wall decoration, which he calls "Muralis." This is said to have the merit of being strong and moderately inexpensive. It is practically linoleum lined with canvas, that it may be fitted up against the wall and ceiling, and is a mixture of linseed oil and fibre rolled on to a fabric, and afterwards stamped by machinery with ornamentation in relief. The specimens submitted to me are artistic in their design, the stamping being clear and sharp, the effect being more like very delicate low relief carving or plaster stamping. The especial merits claimed for it are its warm and comfortable appearance; that it does not absorb moisture, and offers an impermeable resistance to wet from within or without; it can either be put up for dados, or may be put as a decorative frieze, and painted to any colour, to suit the general tone of the room, especially as it can be put up along the whole length of a wall without being jointed; it can be used in the panels of doors or ceilings, and the cost is moderate, some of the best patterns for dado work, about two feet high, being sold for about 3s. a yard. There are many other materials which can be adopted for wall decoration, more especially in the lower portion of the walls, where the room is unequally divided by a high or low dado.

Good tiles can be used in panels, in the walls of halls, with painted figures, or other decorative subjects; but pray do not encourage the use of rough, unevenly burnt tiles, where the subject painting is utterly ruined by the poor character of the tiles. To suppose that this roughness and irregularity gives an air of age, is simply ridiculous; and if it did, it would be setting forth a lie, and be as bad in taste as it is in appearance. I take it that, had our forefathers been able to make tiles as well as we make them now, they would have done so; and it seems to me gross affectation to copy imperfections of any kind. Messrs. Howard have a cheap way of forming wood dados, by glueing on to the wall what they call wood tapestry, which is really only a kind of veneering. This kind of work may be fairly adapted where there is no chance of damp; but I should prefer to see a simple deal painted dado, rather than this wood veneering, which, to my mind, partakes too much of the character of sham to be altogether satisfactory.

In small drawing-rooms, where expense is an object, India or Manilla matting may very well be used as a dado, it is clean, and, thus arranged, fairly lasting. But the use of all these various materials must necessarily depend upon the means at the artist's disposal, and I shall more specially allude to them in the examples which I propose to give in my fourth and fifth lectures, for the decoration of special rooms. After all, most of us will have to be content with the more recent invention of paper-hangings, for the decoration of our rooms; and, thanks to Messrs Jeffrey, Messrs. Crace, Messrs. Morris, and other manufacturers, there is now no difficulty in obtaining artistic paper-hangings of good quality, and at moderate cost. The designs of these firms are of highest possible excellence as regards drawing and colouring, and the colouring and workmanship are as good as they can be.

I am indebted to Messrs. Jeffrey for much information as regards the making of various kinds of paperhangings, and, together with Messrs. Crace, Morris, and Scott and Cuthbertson, for the loan of the large collection of artistic papers which are on the walls to-night. Naturally, the papers all vary in their cost, according to the character, but the examples before you show that the cheapest papers may be equally good in artistic design as the more elaborate specimens. In the cheapest form of hangings, the paper is printed by machinery, that is to say, all the colours are printed at one time, either on self-toned paper, as it comes from the manufacturer, or on paper, which receives a general coloured ground; the prices of them vary from 1s. to 3s. per piece, according to the thickness of the paper used.

The block-printed papers necessarily are more expensive, as they demand much greater skill and

knowledge on the part of the workmen, each colour being printed separately. In all of these papers, gold, so called, can be introduced, the cheaper quality being done in powdered metal or gold size; in the more expensive papers gold leaf is used, by which a much greater brilliancy is obtained, but, even at its best, gold on paper hangings in rooms exposed to the filthy gas of London, and to the humid atmosphere of our climate, is never satisfactory; it loses its brilliancy in a few years, and in newly-built houses, or on walls where there is any draught or damp, it will not stand for any length of time. Some of the raised flock papers of Messrs. Jeffrey, and plain raised patterns, are exceedingly good in artistic treatment and colouring, and are eminently adapted for ceiling decoration, either as an entire covering or in panels, with slight wood enframing mouldings, and for simple decorative friezes. A very good effect may be obtained by the pattern flock-papers on gilding, lacquered over like the old Venetian work; this produces a much richer metallic effect, and the gold is, to a certain extent, protected from tarnishing. White flock-papers, on a light ground, look well for ceiling decoration, without painting, and can afterwards, when dirty, be painted to any tone of colour. Amongst the examples of flock-papers submitted, there is one in Adams's style of decoration, in white on red on celadon green ground, especially successful in treatment. The one advantage of flock-paper in decoration is, that the flock being all wool, can be dyed or stained in any colour, and has much greater softness of tone and colouring than other papers. With the great and varied selections of high artistic paperhangings, such as those made by Messrs. Jeffrey, and which may be obtained at any good decorators from 1s. a piece to 70s. a piece, there should be no difficulty in selecting some good design. It is gratifying to find that high class manufacturers like these, in association with good artist designers, are seeking to prove to the public that paperhangings of high artistic merit, both in design and colouring, may be made to beautify our houses, without going to France for designs, and without slavishly copying ancient patterns and ancient examples. Amongst the patterns submitted there are many which may fairly be accepted as decoration complete, while others are more adapted to form the background for pictures and engravings.

I can only regret that it should be necessary, even with such manufacturers as these, to issue new patterns each year; as artists, their aim should be to combat the shifty nature of a public who will always demand change if they can get it, and will seek for a new fashion in paper as they do in dress; but if this constant change and desire of novelty is to be gratified, it behoves the manufacturer to take heed that his novelties shall mean progress—not mere change—and that each new design shall, if possible, be better in arrangement, better in colouring, and more beautiful in decorative treatment, so that the public who crave after change shall be educated by each new novelty in paperhanging, to a higher standard of excellence and beauty, and thus imperceptibly the art education of the people will be increased and elevated.

Remember always, as Mr. Owen Jones, speaking of paperhangings, in his lecture on the "True and the False in Art," justly says, that "one of the first principles to be attended to in adorning the walls of an apartment, is that nothing should disturb their flatness," and that "all direct representations of natural objects should be avoided; first, because it places these objects in unseemly positions; secondly, because it is customary, in almost every apartment, to suspend on the walls pictures, engravings, or other ornamental works, and that, therefore, the paper should serve as a background, and nothing on it should be offensive or advancing to the eyes." "When varieties of colours are used, the Oriental rule of so interweaving the form and colour, so that they may present a neutralised bloom when viewed at a distance, should never be departed from."

It is a somewhat difficult matter in most London houses, where the ceilings are generally plain, and bordered by cornices of inferior design, to treat them with any amount of colour. In houses of the date of Adams, the ceilings have generally some very delicate enrichments all over them, either flowing or arranged in patterns very slightly raised. Whenever these occur, it is well to treat them almost like Wedgwood ware, with, say, light tones of pink, green, grey, or buff, in very delicate tinting; but where the ceiling is quite flat, it is desirable to tint it a light tone of grey or cream colour, to get rid of the extreme glare of pure white. Next the cornice, a simple distemper pattern, of a darker shade of the same colour, will often be found effective and useful, or one or two simple lines with stencilled corners. The tinting of the cornices must materially depend upon their design and contour; if plain moulded cornices, they may be tinted in one or two shades, the lighter tones being always at the top or next the ceiling, and gradually darkening off to the wall decoration. As a general rule, one or two of the tints of the general groundwork of the paper may be used with effect; if, however, the cornices contain the usual ill-designed and modelled plaster enrichments, care should be taken to keep them in the background, and to pick them out as little as possible, so as to avoid making their general badness of form and execution too prominent. It is well to remember a few general rules in decoration of ceilings and cornices, on which to rely when choosing colours or tints. For instance, in using what are called primary colours on moulded surfaces, it is well to remember that yellow increases, while blue diminishes in strength; the former should, therefore, be used on convex, and the latter on concave mouldings. All strong colours should be definitely separated from each other by light lines, fillets, or small mouldings; colours on light grounds appear darker by contrast, while those on dark grounds appear, as a rule, lighter. If the cornice presents any broad, flat surfaces, a simple conventional flower or geometrical pattern can often be used to great advantage, care being taken not to make it too prominent; the great aim being to keep the general work subservient, and in no way to form a dark moulded frame for the mass of light ceiling. The ordinary system of stencil decoration can be carried out at a very small expense, and, with a few good patterns, very good effect can be obtained in ceilings, where, generally, little or nothing is done; nor is it a very costly matter to lay on to

the flat ceiling, small deal mouldings formed into panels and painted, with the panels filled in with some very light diaper or pattern flock-paper, or stencil enrichment.

Michael Angelo, Domenichino, Vasari, and other artists, covered their ceilings with painting and fresco, beautiful in themselves, but tiring to those who have to look long at them. Michael Angelo, much against his will, painted in elaborate decoration the ceiling of the Sistine Chapel; but Giotto, who knew thoroughly well how to decorate, declined generally to waste his work where it was, at its best, but difficult to see; and in the ceiling of the Arena Chapel we find only a plain light tint of pale blue, contrasting well with his fresco decoration on the walls.

In French ceilings we find many graceful enrichments, especially those designed by Le Pôtre, from whom Inigo Jones probably took many of his ideas and thoughts; afterwards Vanbrugh and Gibbs followed with work of similar character, until the perfection of this kind of cast enrichment was attained by Athenian Stewart, and the brothers Adam, whose delicate detail, fanciful and flowing treatment of design may yet be seen in some of the old houses of London, and are all worthy of study in all plaster decoration.

Carton pierre and canvas plaster are both of French origin, but have been largely introduced into this country by Messrs. Jackson and Son, of Rathbone-place, and are well adapted for general ceiling decoration, as both can be laid on the existing plaster work. Good decoration can be obtained, at moderate cost, by the use of canvas plaster work in low relief patterns, either made to cover the whole ceiling or in panels, with low flat mouldings, similar to those in many of the old houses of the sixteenth and seventeenth centuries; and the material is specially fitted for boldly relieved work in decorative friezes, a good effect being obtained by treating the background in delicate tones of grey, or green, or golden yellow, and having the enrichment white.

Just eighteen centuries ago, within the ancient streets of Pompeii, might have been seen the luxury and splendour of art, form, and colour, as applied to house decoration. The excavations which have, from time to time, been carried on during the last half century, have brought to light marvellous specimens of mosaic and fresco decorations, all showing great skill and knowledge of grouping and composition, and admirable arrangement of light and shade. The examples of friezes, of terra-cotta, and elaborate plaster, bas-relief, and fresco decoration, of great beauty and richness, might surely teach us something of decorative art, and from these examples of brilliant colouring and graceful ornamentation, we might do well, to a certain extent, to accept some hints for their future adaptation or imitation, externally and internally, in our nineteenth century houses. Let me not be mistaken in the word imitation; I do not mean that we are to copy, in our house decoration and ornamentation, examples of work which express only designs from heathen mythology, or stories of life peculiar to an age of luxury, not always moral or in accordance with present taste; but in the graceful drawing of ornamental borders, in the careful rendering of bright and delicate colouring, and in the general treatment of decorative design in plaster work, we may learn many valuable lessons which may help us in our own day and generation.

But here the lesson ceases; we do not want now-a-days stories of heathen mythology, or representations of Greek or Roman legends with which we have little or no sympathy; we may well be sick of processional pictures, representing the scenes of by-gone ages, and of endless arrays of nymphs and heathen gods and goddesses, whose lives suggest nothing but subjects and scenes not always delicate or pure.

I see no reason why, in the houses of the present time we should not have art decorations setting forth some well-known events in the history of the country, stories telling us of the nobility and greatness of those who have helped to make our country the great country that it is.

Why should not painters teach us peace, and good will, and charity, instead of the everlasting nonsense of the "Judgment of Paris," or the "Rape of the Sabines," and in simple decorative work in good drawing and well arranged colouring, help to make our walls beautiful to look at, and examples of art decoration, which shall hold its own with any decorations of past ages?

In the examples still left to us of Pompeiian work, we cannot but notice the great elegance of outline and colouring treated with a master hand, without violent or exaggerated contrasts of light and shade.

Allegory may sometimes be charming, and teach us some real truth, but surely this kind of subterfuge is out of place in the decoration of houses in the nineteenth century, when, at least, common sense overrides romance, and truth and beauty of subject and form should take the place of sickly sentimentalism in design and treatment.

Hogarth and Cruikshank have given us caricatures which, at their best, are neither pleasant in their treatment, or altogether honest in their rendering, and which, even if true, set forth scenes which are wanting in refinement and delicacy, and show us the worst and most brutal side of human nature. Both men were artists of the highest kind, but both failed in nobility and beauty of design. If art is worth having at all, it should be beautiful, and portray grace and beauty of thought and colouring, with subjects emphasising the better life that is in us, and not, like the mawkish novels of the day, pandering to the tastes of those whose thoughts would seem to be in licence and indelicacy, or which nauseate us with all the gross exaggeration and detail of vulgar show or profanity.

The President of the Royal Academy, Sir Frederick Leighton, Mr. Marks, R.A., Mr. Poynter. R.A., Mr. Armstrong, Mr. Albert Moore, and other painters have shown us what can be done in decorative work; and in Mr. Marks' works we have quaint and humorous examples of good decorative treatment, which might well be adapted for humble requirements and humble means.

For us, it is perhaps unfortunate that the greater inducement of painting easel pictures should prevent such men as these giving more time to decorative work; we can only hope that with the increased demand for, and delight in, real art work in our houses, ere long a school may be founded of young artists who will, at fairly moderate cost, be willing and glad to do purely decorative work.

I see no reason why the question which was asked in an article in the *Nineteenth Century*, "Is a great School of Art possible in the present day?" should not be answered in the affirmative, and I believe that, to a great extent, the conditions and views of present life are "such" (to use Mr. Wall's own words) "as might fairly encourage and create a school—a group of painters, sculptors, and architects, whose work collectively should have a force marking the age in which they live, becoming part of the history of the country to which they belong, and existing in the future as a lasting monument of the best feelings and thoughts of the present time."

There is, I fear, at present, among artists a want of that true sympathy in each other's work, and of that appreciation of and respect for each other's talent, which alone can lead to true association of labour and fraternity of toil.

Art decoration is, as a rule, treated as easel picture work, with figures modelled and rounded, and with landscapes and perspective drawing and modelling, utterly at variance with true decorative work. I do not suppose that any painter of eminence could afford to paint decoration, if the work is to be entirely of his own hand; but I see no reason why the master hand should not, with pleasure and profit to himself and those associated with him, and in conjunction with the architect, design and complete good and artistic decoration at a fairly moderate cost.

The master's work should consist, in conjunction with the architect, in designing the general scheme, in adding such touches and drawing as may be necessary to the work when drawn at large on the wall or canvas, and in generally superintending the proper filling in, colouring, and finishing of the work, always remembering that true decoration for walls and ceilings consists in good general arrangement and grouping of figures and foliage, and in broad flat treatment, so that the general effect of the work, when finished, may depend upon good drawing, graceful arrangement, and simple harmonious colouring, rather than on laboured minuteness of detail or elaboration of finish.

It too often happens that, when a painter does do decorative work, he draws and completes it in his studio, seeing nothing of its surroundings or the proportion of the room for which the work is intended, so that to him it becomes more or less an easel picture, to be looked at always on the eye line, and is laboured and finished in strength of colour and detail utterly unnecessary. Then when placed on the wall the effect is unsatisfactory, and either the work itself, or the general decoration of the room has to be toned down in order to secure that harmony of colouring and treatment so necessary for all good artistic decoration.

I am sanguine enough to believe that art decoration can be done well, and at a cost within all our means, and, at the same time, to the pleasure and profit of every one concerned. I see no reason why our best painters should not help us in the revival of decorative work, in the real artistic painting of rooms we live in, and the houses we dwell in, even as Fra Angelico, Giotto, Corregio, Michael Angelo, and many other great masters did in days gone by. Why should not our rooms contain life stories of noble deeds, of good works, of home scenes, such as would appeal to the better life that is in all of us, and remind us of some good work, some noble truth? Why should we not set forth on our walls some of the scenes from Chaucer, Spencer, Shakespeare, Tennyson, or other poets? Surely they would furnish us with ample variety of subjects, grave or gay, and the lessons and home truths would be made more intelligible and more beautiful by pictorial representation.

You will say that this is all very well for family houses which are handed down from father to son, and in which the art so produced is a part of the inheritance; but even in the every-day houses of town, in which we rest to-day and are gone to-morrow, some such work can be done on panel or canvas, and remain as much our own property as the pictures or drawings that we hang on the walls. One such decorative subject, done under the supervision of a good painter, is worth all the prettinesses of decorative work in gold and colour, or all the bad ornaments of conventional form which money can buy, or mere decorators can design for you; and one such work of pure decorative art will give more pleasure than all the stamped leather or *bric-à-brac* with which so many of us delight to load our walls. It is better to have a room decorated by the hand of a master than all the industrious pattern work which hands can make, for if "life without industry is guilt" "industry without art is brutality."

I believe there are, amongst our younger painters, many who would gladly help us in such work; and it is well to remember that the fame and the honour of many of the great masters of olden days, rest more upon the purely decorative work they left behind them, than on any amount of easel pictures; that the frescoes they painted are, after long centuries, still left to us to study and admire, when the mere moveable canvases are lost or destroyed.

It would perhaps be impertinent for me to suggest that the Royal Academy might do something towards providing for and fostering a school of decorative painting; but I venture to think that they, with all their great wealth and power, could do more than any private individuals towards providing for a real and national school of decorative painting; their students would be continually adding new blood, and, from a mere business point of view, the younger painters would find that not only money but fame and reputation would be equally well attained by decorative work, as by painting easel pictures, or illustrating books or newspapers, and thus eventually we should be able to obtain, at moderate cost, a higher character of artistic decoration throughout the country, and to bring art work within the reach of thousands, whereas at present it is only to be obtained by those with whom price is no object.

It is all nonsense saying that this kind of work is for the tradesman decorator, and not for the artist himself. I take it the selling of a picture is as much a matter of business, as much a matter of profit and loss, as any other work of human brain and hand. The artist is, or should be, as much a man of business as any other good member of society, and it is a misfortune to himself and his clients when he is not. As a mere matter of business, he may, if he will, find it worth his while to dedicate in part the thoughts of his fertile brain and the work of his facile hand

and brush, to decorative design for every-day homes.

I am indebted to my friend Mr. Marks, who, some ten years ago, was good enough to decorate my own house, for taking up this subject in a business-like and tangible manner, and to show his approval of what I have for years been advocating, by doing what he called two or three "show-cards" to illustrate this portion of my lecture. These are hung on the walls, and I submit are admirable examples of what simple decorative work in the hands of a master may be. They consist of decorative treatment of birds and foliage in oil and tempora, the large example being worked out in a more naturalistic form than the smaller sketch which shows a flat treatment of less expensive character. These are of course only suggestive, and may be amplified or simplified to any extent, either in combination with figure work, which adds to the cost, or without it. I believe this has been carried out in association with a younger artist, with a view of obtaining the result I seek for, namely, good art combined with moderation of cost.

If the narrowness of worldly circumstances prevents us from having figure decoration in our rooms, we may still have in distemper or other media, panels of coloured decoration of birds, or other natural objects, treated simply and inexpensively, so as to come within the means of us all.

In my future lectures, I shall deal more definitely with panel and wall decoration applied to special rooms and situations.

In concluding this, my second address, I suggest for your consideration whether it is not desirable, from mere economical motives, to decorate your rooms a little more artistically; if the walls be of the usual bare type of one pattern paper or paint, you must do something to hide their bald and cold appearance by hanging on them engravings, pictures, or other artistic objects. How much better then, would it be to spend the same money in having some really good art decoration, which should be a source of continual pleasure and delight.

In our dreary London rooms there might be internal light and colour, that should help to make us almost unmindful of the dinginess and smoke without, and add much to the comfort and home-like feeling which good colour, good designing, and good taste cannot fail to give.

MISCELLANEOUS.

INSTRUCTION IN MUSIC IN ELEMENTARY SCHOOLS.

Extracts from the Reports of Her Majesty's Inspectors of Schools for the Year 1879, showing the Progress made in Instruction in Music or Singing.

"It is painful to see big boys and girls stand up to sing the insipid doggrel wedded to pointless melody which fills up most books of school songs. Shall the teacher be advised to teach by note? The children shall wearily climb the staff to find, when they reach the temple of music at the top, plenty of rubbish like what they left below. Better no instruction in music than that which leads to the natural conclusion that music is stale, flat, and unprofitable. The knowledge acquired will soon be forgotten, not so the disgust.

"In about a score of schools in my district part-songs are tastefully sung; in about a dozen (but there may be some in which lack of time has checked my inquiry) the "movable *do*" enables the children to read simple music. In many more, however, the power of music is felt. Exact and telling rhythm is often obtained even in infant schools. The power of exact rhythmic movements is immense, and seldom used as freely as might be. But it must be exact."—Mr. T. S. Aldis, Inspector, Harrogate District, p. 216.

"With scarcely an exception singing is universally taught, that of the Roman Catholic schools being the best. The children generally learn by ear and not by note, but part-songs are by no means uncommon, and when the harmonium is used I am careful to satisfy myself that it is only as an accompaniment, and not merely for the purpose of supporting the voices or concealing defects.

"The following schools are the most proficient in this subject:—

Consett, St. Patrick's, Roman Catholic, mixed.
" " " infants.
Durham Model, boys.
Newbouse, St. Mary's, Roman Catholic, mixed.
Shincliffe Colliery British, mixed.
West Kyo Board, mixed."

—Mr. Bernays, Inspector, Durham District, p. 227.

"In a great majority of the schools singing is not a success. In most cases, perhaps, this is owing to a want of musical ability on the part of the teachers. In the others I am afraid it is partly owing to the fact that the subject does not pay to teach well. For purposes of grant, the best and the worst singing in the district are on an equality. Singing by note is rarely attempted, nor is it likely to be until the Code distinguishes between that and singing by ear. Bowdler's School, Shrewsbury, has achieved marked success in singing. The pieces got up for inspection were sung in very good harmony and with good expression. The children also sang at sight, with very fair success, several rather severe test passages. There are, I feel sure, many other teachers in the district able to bring about the same results. Singing, whether by ear or note, is a valuable aid to discipline. This is lost sight of by those teachers who treat it with such coldness. In infant schools it is especially valuable, and I am sorry to see it so little used for that purpose. Take, for instance, action songs. What agreeable relaxation, and yet what training in prompt discipline there is in a well executed action song. As a rule, however, these songs, as executed on examination day, only serve to show the want of discipline, and are certainly not enjoyed by the children. I think, also, that singing ought to enter much more fully into the daily school life of infants than it does at present. Most pupil-teachers decline to take the music paper at their examination, and very few of those who take it do themselves credit. It seems a pity that there is no opportunity of testing their practical knowledge of, at least, vocal music. I think such a test would add considerably to their interest in the study of music, and must re-act favourably on the schools."—Mr. S. K. Booth, Inspector's Assistant, Shrewsbury District of Shropshire, pp. 243-4.

"Of music there is little to be said or heard. That it is possible to teach a considerable amount of music in conjunction with many other subjects, I cannot now doubt, because I have known the thing done. The master of the third grade grammar school at Wellingborough used to submit patiently to losing the grant for music. I argued with him on the subject, and said

that he might as well get up his dozen songs like his neighbours. He declined, however, to take my view of the question. But last year I found that he had taken up music. No songs, however, had been learnt, only exercises. These were correctly sung, and the boys could construct a scale upon any key-note on the blackboard, and give the chords. Most wonderful of all, they could tell, without fail, the interval between any two notes sounded by me consecutively or together on the harmonium (of which they could not see the key-board). This is the only instance of musical teaching attended with marked success which I have met with. A few schools only make any attempt at systematic musical teaching. It is to be regretted that the name music should have been selected for describing that for which the additional grant is habitually paid. I should have preferred to see the schools made a present of the money for average attendance simply. There is a danger at present that the children in our schools may be really induced to think that what 'Government' is content to accept as music must be the genuine thing."—Mr. CURREY, Inspector, County of Northampton, p. 261-2.

"Yorkshire children, like their neighbours in Lancashire, appear to be born songsters. I had always been doubtful before how far notes were of use to children who so readily pick up any tune that they hear once or twice."—Mr. DIBBEN, Inspector, Wakefield District, p. 279.

"I give below the names of certain schools in which the singing is remarkably good:—Wanstead National (boys'); Romford, St. Andrew's National; Stratford, St. Paul's National (boys'), ditto (girls'); Barkingside, Mossford Lodge Industrial; Stratford, Girls' British; Plaistow, Balaam-street Board (boys'), ditto (girls'). Coarseness, want of modulation, objectionable mannerisms (such as dwelling on the last syllable of a passage), drawling and harshness are, so far as I can judge, the most prominent defects. In some country schools boys may be heard singing the tune an octave too low. Ignorance of the method of starting a tune is often shown. I also find cases where the children have always sung to the harmonium, and cannot sing accurately without its aid. Singing should always be given standing, and the teacher should not sing, except in illustration of some passage, or to correct a fault."—Mr. HELPS, Inspector, Chelmsford District, p. 301.

"If better music is to be taught to children in the future, the musical training of the pupil-teachers must receive greater attention both in theory and practice."—Mr. G. WADE, Inspector's Assistant, Leeds District, p. 328.

"Singing needs but a single word. Why not make 'singing by note'—of course, on any recognised system—a subject under 19 C? Needlework is already an essential, and yet systematic needlework is 'special.' I am certain that a large number of teachers can and would teach by note—many do so to some extent now, who do not report it—if it led to any tangible result."—Mr. MONCREIFF, Inspector, Bristol District, p. 338.

"Singing is taught in all my schools with the exception of, I think, two. Inhabitants of a mountainous country, we are yet, by some strange accident, an unmusical people. Not that we are 'fit for treasons, stratagems, and spoils.' The defect is due, not to natural inaptitude, but to want of training, and is, indeed, fast disappearing. It would surprise Sir George Bowyer to mark how rapidly unsuspected voices and ears are discovered by the simple expedient of daily scale-singing, and how frequently two or three years suffice to develop the power of rendering part-songs with taste. £100,000 of public money is well spent in adding an innocent pleasure to humble life at the modest remuneration of 1½d. per song."—Mr. TREMENHEERE, Inspector, Kendal District, pp. 423-4.

"In singing I cannot report the progress I had hoped for; in a few schools two parts are taken, the master adding also a bass or tenor, but more generally it is in a harsh and monotonous unison, not unfrequently so out of tune as to be a veritable infliction to any one blessed (or cursed) with a good ear."—Mr. WADDINGTON, Inspector, Monmouth District, p. 435.

"I am sorry not to be able to report any progress in musical proficiency. I do not expect to find any marked improvement until direct encouragement is given to singing from note. Many teachers can do this, but they are not ambitious enough to attempt what does not 'pay.' The best form of encouragement would perhaps be to make singing from note a specific subject of instruction under Art. 21. The songs now required are frequently very agreeably rendered, but I now make a curious statement, supported however by facts, namely, that very often the more time given to singing the worse it is. It is easy to see this may be true, for where a teacher has no musical power, much time may be uselessly employed in trying to meet the present requirements, requirements which can, at the expense of but little time and labour, be easily secured by competent teachers. Another curious fact in connection with this subject is that very inferior results are often produced by teachers of very decided musical power."—Mr. WILKINSON, Inspector, Lichfield District, p. 454.

"Singing is taught in all the schools which I have inspected, and I have been able to recommend the grant in every case. But it has sometimes been so harsh that I have begged the teachers to silence those who had either 'no ear' or an utterly unmusical voice."—Mr. CAPEL, Inspector, Warwick and Coventry Districts, p. 235.

PROFESSOR BELL'S PHOTOPHONE.

A correspondent sends to the *Times* an account of Prof. Graham Bell's photophone, as described in a paper read by Mr. Bell himself at the recent meeting of the American Association for the Advancement of Science. According to this paper, says the correspondent, Mr. Bell has performed a very marvellous feat indeed. He has succeeded in telegraphing, or rather "telephoning," along a beam of light. The beam of light took the place of the ordinary connecting wire, and by its means, sounds produced at one end of the beam, were reproduced at the other. The invention (for such it is rather than a discovery) may or may not have any immediate practical application, but of the scientific interest attaching to it there can be no question. As with the telephone, simple means and well-known properties are made to produce startling results. Startling, however, as they are, they will certainly meet with ready acceptance here. There is nothing in Mr. Bell's paper which does not fit in with previously known facts, and its author's reputation alone suffices to prevent any hesitation in receiving his conclusions.

The curious properties of the rare metal selenium are well known to electricians, and have frequently been made the subject of experiment. The property which is believed to be peculiar to itself is that of offering more or less opposition to the passage of electricity, according as it is acted upon or not by light. It is, therefore, easy to conceive that if a piece of selenium were introduced into an electric circuit, in which was also a telephone, alternations of light and darkness might be caused to vary the strength of the current, and such variations would produce sound in the telephone. This

may be made clearer by considering the analogy of the microphone, for the selenium would act, in fact, as a microphone sensitive to light. In the microphone, mechanical vibrations vary the conductivity of the materials of which the instrument is constructed. In the case of selenium, the luminous vibrations affect the conductivity of the metal. In either cases these variations of the current would affect the whole length of the current, and would be manifested by a sound in the telephone. This idea was put forward by Mr. Bell himself in a lecture in England two years ago, when he stated he believed it would be possible in this manner to "hear a shadow" fall on a plate of selenium. But it was found that attempts to realise the idea failed, because the selenium was so bad a conductor; its "resistance" was so great that it could not be used with so sensitive an instrument as the telephone. Mr. Willoughby Smith, a well-known English electrician, stated at a meeting of the Society of Telegraph Engineers that he had succeeded in hearing the fall of a ray of light on selenium; but this experience does not seem to have been repeated. The solution of the problem appears to have been due to the discovery by Mr. Bell of a method of treating selenium by which its conductivity was increased. Selenium, like the more common element, sulphur, exists in several states. In one of these states, the "vitreous," produced by melting and rapid cooling, it is a non-conductor. In its "crystalline" or "metallic" form, produced by melting and slow cooling, it conducts electricity, though feebly, and it is in this state that it has been experimented with. By a method of heating to a certain point and then cooling, and by certain improvements in the method of attaching the connecting wires, Mr. Bell succeeded in constructing "cells"—small plates fitted with conducting wires suitably arranged—of selenium, the resistance of which might be denoted at 3, while the best previously made was as 2,500 (300 ohms and 250,000 ohms) in the dark. On exposing the cell to light the resistance was diminished to about a half (155 ohms). By this means the fall of light—the blow struck by a ray—was rendered distinctly audible.

So far, Mr. Bell had only improved on what had been accomplished by other inquirers. His next step was more original, and one which, perhaps, would not have suggested itself to any mind not already intent on the problem of conveying sound from place to place. The idea once suggested, it is not difficult to conceive that if the intensity of the light falling on the selenium were caused to vary in correspondence with the vibrations, say, of the human voice, such vibrations would be faithfully reproduced in the telephone, and the voice would be heard. Further, the apparatus for thus regulating the impact of light might be removed to some distance from the selenium without affecting the result, so long as the beam of light shone with sufficient strength upon the sensitive cell. We should then have sound conveyed by light, or at least light affected by sound at one point in such a way as to be capable of reproducing sound at any other point to which it might be reflected.

The apparatus used by Mr. Bell is of a sufficiently simple character. A plane mirror of flexible material, such as silvered mica or miscroscope glass, is employed to reflect the light—sunlight or a strong artificial light, concentrated upon it by a lens. The speaker's voice is directed against the back of this mirror, which is thrown into vibrations in the same way as the diaphragm of a telephone, and communicates these vibrations to the beam of light. The light reflected from the mirror is, after passing through a second lens, received at the distant station by a parabolic reflector, in the focus of which is placed a selenium cell in circuit with a local battery and telephone.

With instruments arranged as above described, Mr. Bell states that a number of trials have been made, over distances too great to permit of sounds being heard directly through the air. The greatest distance mentioned is 213 mètres, or about 230 yards. Mr. Bell believes that similar results may be obtained at whatever distance a beam of light can be flashed from one observatory to another. This belief requires experimental verification, and until it is so verified it will be wise to reserve the expression of opinion as to its possibility. Should the inventor's hope be realised, his apparatus will have important practical applications. In circumstances such as those in which the heliograph recently proved itself so useful, the "photophone" would be still more valuable.

For experimental purposes, a different apparatus was used. By means of a perforated disc rotating before a fixed perforated screen, a beam of light was rapidly interrupted. These rapid alternations of light and darkness falling on the selenium produced a musical note in the telephone, the rotating disc itself being absolutely silent. Light is thus made to produce sound, and the ancient fable of Memnon's statue is realised by modern science. Aided by his rotating disc, Mr. Bell has found that many other materials besides selenium are affected by light, faint sounds being audible from the bodies themselves, without the intervention of a telephone and electric battery, when the interrupted beam is incident upon them. Probably these results will need further experiment before they can be finally accepted. For instance, Mr. Bell does not state what precautions he took to prove that the effect was not due to heat, or under what conditions and how often the test was made.

The instructions given in the paper seem to be sufficient to enable anybody to try Mr. Bell's experiments for himself, and doubtless many will soon do so. Without, however, waiting for the results of such experiments, I think we may congratulate him on having at once made an addition to our scientific knowledge, and discovered another possible application of science to practical purposes.

OBITUARY.

Miss Jane Chessar.—Miss Chessar, who died on the 3rd instant, at Brussels, where she was attending the Educational Congress, though not a member of the Society, on many occasions rendered it assistance. She served on one or two committees in connection with the Congresses on Domestic Economy, held by the Society, and contributed papers which were read at those Congresses. Miss Chessar had always been connected with educational work. She began as a teacher, on the staff of the Home and Colonial School Society, and afterwards conducted classes at the North London Collegiate School for Girls. In 1873 she was elected on the London School Board, and remained a member of the Board for three years, her health preventing her seeking re-election in 1876. She also took great interest in, and worked heartily at, various schemes for the improvement of female education, and the improvement of the position of women.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,454. Vol. XXVIII.

FRIDAY, OCTOBER 1, 1880.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council are Trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "Students of the Schools of Art who in annual competition produce the best Designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones;" the prizes to "consist of a bound copy of Owen Jones's 'Principles of Design,' a Bronze Medal, and such sums of money as the fund admits of."

The prizes will be awarded on the results of the Annual Competition of the Science and Art Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

The next award will be made in 1881, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

SECOND REPORT OF THE COMMITTEE ON MUSICAL EXAMINATIONS.

The Committee have considered the following brief history of the National Training School for Music, in view of introducing into its training any modifications necessary to promote especially the national cultivation of Music throughout the United Kingdom.

I. This school was originated at the cost of the Society of Arts, to be under trial for a period of five years, and it is now entering upon the last year of the trial. The school has been carried on successfully for four years by voluntary support, and has paid its way. It was initiated with the full intention that it should, and under the confident hope that it would, eventually be transferred to the responsible management of the State. And hopes were expressed that, at the expiration of this period, "the British Empire will so recognise the utility of the institution, that it may be engrafted upon the system of National Education, and be made part and parcel of Science and Art Instruction, directed by a Minister of Public Education." These announcements were made in the statement read on the occasion of laying the first stone of the school on 18th December, 1873, by his Royal Highness the Duke of Edinburgh. (*Journal*, 19th December, 1873, p. 75.)

II. A memorial has been presented by the Training School to the Commissioners of the Exhibition of 1851, praying them "out of the vast funds entrusted to them for the encouragement of Arts and Sciences, to confer on this School such an annual endowment in money as would enable the Committee of Management to appoint professors of modern languages, to subsidise eminent performers to take leading parts in the orchestra, to engage lecturers on musical physics, and to establish classes for dramatic instruction." The reply of her Majesty's Commissioners was to the effect that "if the school could be united with the Royal Academy of Music, to form together the nucleus of a large institution, which could be placed on a more permanent and extensive basis than any existing institution of the kind, such institution would fall more directly within the scope of the operations of her Majesty's Commissioners, and might look to them for substantial help." (See Second General Report of the Training School from 1876 to 1879, p. 14.)

III. Accordingly, negotiations were opened with the Royal Academy of Music, but they have led to no result. A similar attempt was made in 1872, when the National Training School was about to begin its working, but that also was unsuccessful. It should be remarked that, in 1866, an attempt, by Lord Wilton and Sir G. Clerk, was made, when Lord Granville was Lord President, to induce the Royal Academy of Music to become a National Training School for Music, but that attempt too, came to nothing. On 15th June, 1875, H.R.H. the Duke of Edinburgh, at Marlborough-house, when H.R.H. the Prince of Wales held a Conference for the purpose of establishing Free Scholarships, gave a history of the measures taken by the Society of Arts, from 1865. At that time (1865) it was proposed by the Academy to surrender its Charter, but since then the Academy, through the exertions of its professors, has become flourishing, and in the year 1879 its income exceeded £13,000.

IV. The hope expressed by the Society of Arts, in 1873, that the Training School "might be engrafted on the system of National Education, and be made part and parcel of Science and Art Instruction, directed by a Minister of Public Education," has lately received encouragement in the fact that, in the year ending July, 1879, upwards of £128,680 10s. had been expended by the Education Department for singing by ear alone in elementary schools. (See returns to the House of Commons obtained by Sir Charles Dilke, Bart., in 1879 and 1880.)

V. The Musical Committee of the Society, appointed in 1879, issued a "Directory containing a scheme for establishing local Music Schools, to be connected with public Elementary Schools, and with some Central College for the highest Instruction in Music," and they expressed an opinion "that proper instruction in Music in elementary schools need not lead to any increased expense." The Committee also called attention to the fact that efficient instruction in drawing in elementary schools, night classes, prizes, &c., only costs £56,000 a year, after 20 years' working of the system. It may, therefore, be inferred that the possible saving out of the annual expenditure of £128,000 now paid for singing only, would be ample to endow a National Training School for Music, and establish a system of national competition for obtaining students endowed with musical gifts, besides providing for vocal music in local and ele-

mentary schools, &c. And public opinion seems to be maturing in this direction.

VI. The Education Code for 1880, in conformity with the views expressed by the Musical Committee in their first report, have altered the grant of 1s. for singing, into 1s. for singing from notes, and 6d. for singing by ear. This change, if sanctioned by Parliament, may be expected to effect an economy which might well be appropriated to the support of students in training in the National Training School.

VII. Under the conviction that, before April, 1881, the subject of the National Training School will have to be reviewed, the foregoing brief statement of facts has been prepared for the consideration of the Committee of the Society of Arts on the National Cultivation of Music.

By order,
H. Trueman Wood, Secretary.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

(*The right of reproducing these lectures is reserved.*)

Lecture III.—Delivered Monday, April 19th.

The Decoration and Furniture of Town Houses.—Furniture.

The subject of my lecture this evening is "Furniture;" and although, to a certain extent, I propose to treat it generally, reserving more special description for my next two lectures, I yet hope to make it of sufficient interest to warrant me in keeping you for the brief time during which I shall address you.

It is probable that you all have your own individual opinions as to the best ways of furnishing the houses you live in; and if not, you may possibly say that, in these days of Queen Anne architecture, and fine art manufacture of all kinds, there will be no difficulty in obtaining anything that is wanted of fairly good taste, and which shall combine beauty and appropriateness of form and design with usefulness and comfort.

If, in my remarks, I fall foul of the mere ordinary manufacturer of so-called art work, it must be distinctly understood that I fully recognise the important progress made by such firms as Messrs. Jackson and Graham, Gillow, Trollope and Co., and other well-known manufacturers, who have practically spared no pains to produce the best possible work, and have brought into association with themselves a number of artists, of high repute and knowledge, to aid them in their endeavours to give to the public furniture of throughly good art design, comfortable in shape, and sound and good in workmanship.

My quarrel is with the crowd of imitators who, appealing to the ignorance of the public rather than to their taste, endeavour to foist upon them goods which are said to be of the newest fashion of some particular style, which, like all other fashions, will soon be as obsolete as the imitations of the "sella curulis" and the bronze "bisellium," to which we were so freely treated at the end of the last century, are at the present day.

As I said of decoration, so do I now say of furniture, that the higher art cultivation of individuals, and, as a sequence, of the whole community, is not to be arrived at by setting up any particular style or fashion of design, or by the narrow dogmas of interested persons who, regardless of expense, insist upon the necessity of this kind of wall hanging, or that shape of chair or buffet, and who, skilled in the use of fine sounding phrases, and with a knowledge of the baser elements of human character—which delight in slavish imitation and so-called fashionable conceits of a passing style—seek to advertise their wares as "Queen Anne," "Old English," or "Chippendale," "Adams," or mediæval, and appeal more to the ignorance than to the real art knowledge and taste of society.

The word furniture, in its ordinary acceptation and interpretation, "represents anything that is moveable, transportable, and easy to place in security."

In my address this evening, I propose to include all the general fittings of a house, which, to a certain extent, would now-a-days be called "fixtures," such as mantels and stoves, hanging closets in bedrooms, shelving, built-up buffets, and other special joiners' work, which, I hope to show, may well and economically take the place of the more moveable and expensive articles of furniture. Let me say here that there is no absolute necessity that any of these closets or shelf-clusters should be made absolute fixtures, so that of necessity they become the property of the landlord at the end of a given term of years; they can all be made separate and distinct, to fix in their various places, screwed into blocks or hanging pieces fixed to the walls, and can, if not bought up by the incoming tenants, be, as a rule, removed and adapted for the new habitation.

I wish particularly to advocate the greater use of these fittings for recesses in various rooms, as they can be made much more inexpensively than the usual moveable furniture, can be adapted to the general character of the rooms, and, if made as I shall hereafter describe, will save much labour in dusting and cleaning, and will not form resting-places for the dirt and filth that accumulate in town houses, on the tops of wardrobes and other pieces of furniture, the height of which prevents their being constantly dusted and kept clean.

In the furniture made by our best manufacturers, there is evinced a careful regard for grace and harmony of design, combined with use and suitability; and this must be attributed to the fact that the designers are not mere designers of chairs, tables, and curtain hangings, but men who, like the artists of the Middle Ages, believe that every creation of design should be as honestly and thoroughly thought out—whether it be the smallest fitting of a house, the commonest colouring of a wall, or the decoration of the smallest panel of a buffet or cabinet—as the most gorgeous edifice, the most exquisite painting, or the most noble piece of sculpture. Quite certain it is that no good work can be produced by the cramped efforts of designers, who see nothing beyond the mere buffet, chair, or table they may be working upon, and who cannot realise or conceive the proportion and place each piece is to take in the general arrangement of the room or building it is designed for.

It will be well for all English art when architects, sculptors, and painters, like the artists of the

Renaissance age, consider nothing too small or insignificant to engage their thoughts and artistic skill; when, like them, they shall in no wise consider it derogatory to their rank to think out and design the lowliest piece of furniture, or the pattern or colouring of the smallest article, whether of wall-hanging, floor-covering, or general fittings of a room.

As in decoration, so also in furniture, the art student and workman, as well as the general public, are largely indebted to the various exhibitions and loan collections which have from time to time been formed in this country and abroad, during the last thirty years, for a more general knowledge of the furniture of past ages, and for the opportunity thus given for careful study and comparison of the work of various epochs. The vast amount of good examples brought together at South Kensington offers not only an opportunity to the mere sightseer to improve his knowledge of ancient work, but gives the art workman and designer a chance of studying the characteristics of design and construction, in the numerous beautiful objects thus brought together; and has, without doubt, imperceptibly imbued them with a higher feeling for beauty and truthfulness of design, and led to greater skill of handicraft, in the work of the various trades especially cognate to the chief art of architecture.

Furniture has, in all ages, to a great extent, followed the fashion or style of the architecture of the period; both, in early times, were made to conform to the customs and requirements of the people of the particular age.

It is true that, after the golden age of the Italian Renaissance, when all the great arts of architecture, sculpture, and painting were combined in one great and harmonious effort, the sister arts of painting and sculpture became more or less severed, and began to start into independent life and existence.

After the sixteenth century, in furniture as in architecture, there was a manifest decline in artistic design, proportion, and beauty, in favour of a degenerate taste in design, and great exaggeration and capricious eccentricity of form and treatment, until in the eighteenth century there was, for a brief period, a return to greater simplicity and soberness of design and form. The reaction from the voluptuousness and exuberance of the past century brought back for a while greater and better taste in all design, and a seeming desire to return to the grace and beauty of delicate classic character and feeling.

Still later, the designs of furniture as well as of decoration were, to a great extent, copied from the wall paintings of Pompeii; this fashion, however, had but a short and fitful life, degenerating in a few years into feeble prettinesses, false construction and taste, and great extravagance of cost; each individual followed his or her own caprice, and furnished in the style and period each thought best; the result was a lamentable jumble of works, exemplifying no particular conditions of life, and leaving no particular record of their own, or of the feelings of the age to which they belong, except, perhaps, a bad record of absolute copyism, based on no real knowledge of, or regard for, the style of any particular age, but subject only to the changes of individual caprice and fashion.

While we cannot but admire the great beauty of design and workmanship of the larger and more important pieces of furniture of past ages, and may be glad to become possessors of them as works of art, even as we may delight to gather around us examples of beautiful sculpture, painting, and other art work of bygone ages; we can hardly, in these days, desire to imitate their luxury or costliness of make or design; and while we may welcome them as charming additions to our art collections, we should, I take it, hardly desire to see them imitated for the changed condition and requirements of our own day.

Altered social conditions of the day have changed the habits, customs, and requirements of modern society. Now-a-days, our cabinets have to contain beautiful specimens of porcelain and pottery, of gold and silver, and other metal work, tissues and other objects of art which we desire to be seen by our friends, and not to be hid away behind panelled doors or elaborate inlaid fronts.

It was not until the end of the sixteenth century that furniture applied to every-day use became general. It would be outside the intention of the present course of lectures to enter more at large into any description of the elaborate carved "armoires," "dressoirs," or sideboards, whence our term "dresser," or of the high chairs; or "faldistoires," with their monumental backs, the revolving desks, or "wheels," used for the purpose of keeping books and manuscripts within reach, the "lecterns," and other similar pieces of furniture of the fifteenth and sixteenth centuries; suffice it to say, that although highly elaborate in their design and workmanship, they were made, as a rule, conformable to the requirements and luxurious tastes of the day, and were, with all their elaboration, thoroughly and entirely adapted for the purposes for which they were designed.

M. Jacquemart, in his most interesting and exhaustive history of furniture, enters at large into the description of the furniture of past ages, and the various alterations in ways of living, which practically brought about the changes in furniture design and arrangement.

Before leaving this part of my lecture, it is well to notice how gradually the simple pieces of furniture of the earliest became amplified and enlarged to meet the more luxurious requirements of modern times. To quote M. Jacquemart:—

"The simple 'credence,' a table for writing or tasting provisions, as its name indicates, became an elegant cupboard breast high, often with flaps, and a small undershelf: then it is completed by a back-piece, and even by a shelf, passing on thus to the form of the buffet. This latter name was originally given to the room destined to contain the most valuable plate; later on it was applied to a piece of furniture serving the same purpose, and, by analogy, to the articles which decorated it. The "dressoir" or "étagère" differed little from the buffet; large pieces of gold plate and other sumptuous articles were exposed there, the number of the shelves being fixed by etiquette, according to the rank of the persons."

Then there were chairs, or "chaïeres," plain and folding, revolving chairs (*chaises à pivot*), and the gossiping chair (*chaise cuquetoire*), somewhat analogous to the "causeuses" of modern times; then there were the double-bodied presses or "armoires," or cabinet turned into cupboards, with

folding doors, and tables, beds, and seats of all description."

Later on, China and Japan contributed to the furniture of the houses of the wealthy various small pieces of furniture "de luxe," of red, gold, and black lacquer; India and Persia, a variety of pieces in sculptured and sandal wood, and elaborate "piqué" or inlaid work; Italy, its gorgeous specimens of carved, incrusted, and inlaid ivory, mosaic, and marquetry work, until, in the seventeenth and eighteenth centuries, we descend to the extravagance of design and ornamentation in bulbous-shaped forms, overlaid with tortoise-shell, and gilt and chased metal work of all descriptions, with all the gingerbread and show of twisted and curled gilt mouldings, and elaborate mirrors; all these articles were made more for show than real use; in them (to quote M. Jacquemart)—

"Form usurps unheard-of license, every object swells itself to assume fantastic curves; nothing is straight or regular. Angles are rounded and hollowed, unlooked for sinuosities farrow the surfaces, bulged twisted caricatured forms are alone admitted, and above sprouts bronze vegetation with unnatural endive foliage; brass gilded with ormolu, rolls along in fantastic borders, or gathers suddenly in unforeseen clusters, and thus an eccentric whole is completed, which, while always clever, is sometimes elegant notwithstanding its singularity; although caprice is carried to such extent that the fundamental law of art-propriety is totally forgotten."

The period of Louis XVI. brings back upholsterers to sobriety and simplicity, and the general character of the delicate artistic designs and workmanship of this time is influencing the revival of art furniture to a large extent in England, combined with the works of the English designers, Sheraton, Chippendale, and Adams, whose designs are being now largely reproduced to suit the present fashion of architecture, yclept "Queen Anne."

In the work of Chippendale, we see great carefulness of construction, general comfort, and suitability of form and arrangement; although in many of his designs, there is a manifest imitation of French or Chinese ornament and form which is anything but satisfactory, and the elaborate and delicate fretwork and carving naturally tends to make any imitation of his designs expensive.

As a type of old work suitable to houses of the present day, there is much in the modern imitation of Chippendale work which commends itself to the present style of house-building. It is to be regretted, however, that the craze for all this kind of work should practically not only give the dealers the chance of charging exorbitant prices for old examples, but, to a certain extent, encourage a somewhat extravagant idea of the worth of modern imitations.

Heppelwhite was another manufacturer of this period, who endeavoured to combine general elegance of design with comfort and suitability of form, and whose work is now much valued by *connoisseurs* for its general goodness of make and design. In the work of both these makers, solidity, comfort, and sound construction are especially noticeable, while there is an absence, as a rule, of expensive ornamentation, and unnecessary turning and cutting.

Sheraton was another maker who, in the beginning of this century, brought the art of furniture-making into high repute, and whose work may generally be said to be based on that of Heppelwhite and Chippendale, with the addition of painted decoration inserted in friezes and pilasters.

I am quite aware that first-class workmanship is well worthy of first-class prices; but I cannot but think good modern upholsterers might give us furniture, made after the manner and form of the makers I have named, at a somewhat less extravagant price than that generally charged. A good deal of the unnecessary carving in the chair backs might be omitted, and while the general excellence of the designs, as regards form and comfort, might be adhered to, they might in a great measure be simplified, so as to bring the price within the reach of all of us.

A good dining-room chair, artistic in design, comfortable in shape, and of good mahogany or oak, covered with leather, or other good wearing stuff, ought to be made for £3 or £3 10s.

I am indebted to Messrs. Jackson and Graham, and Messrs. Gillow, for the loan of some exceedingly good examples of modern, so-called, Chippendale and Sheraton work, in which general simplicity of form, and honesty of construction and design, are set forth. I want to see such firms as these give us this kind of work at a more moderate price, and I see no reason why this cannot be done.

While it is of course possible for those whose means are unlimited to obtain good artistic work, the largely increased use of machinery should enable us to obtain this at moderate cost; for although we must necessarily be dependent upon skill of pure handicraft for many articles of furniture and decoration, there is no real reason why machinery, properly applied, should not be made the means of producing good work for the million.

After all, the manufacturer must not be entirely blamed for extravagance and high prices; common sense in house decoration and furnishing has not yet been arrived at by the majority of the public. They are content to accept advice in most important matters, but imagine that they can, without help, furnish and decorate their homes, and, in matters of taste, believe that they have as much a right to have an opinion as the skilled professional artist.

This want of plain common sense often leads them to avoid asking the opinion of those who will naturally seek to over-ride their own real "want of taste," and, as physicians of art, to lead them away from their commonplace, vulgar, and oftimes probably grossly extravagant ideas, to those more simple and inexpensive. Hence, they hand themselves over, body and soul, to some inferior decorator—whom they think they can lead—who begins by bowing down to their own expressed whims and fancies, flatters their vanity and conceit, and ends by perpetrating the grossest of anachronisms, and supplying the vulgarest of designs in decoration and furniture, at a large and oftimes excessive outlay of money. If an artist offers advice, as an "*amicus curiæ*," unless it should happen that it be in accord with the wishes of the individual, he will probably be politely snubbed, and told that it is "a question of taste," and that he or she knows best what he or she likes. Of course it is a question of taste, but of educated taste, not of mere whim or fancy. I could quote

innumerable examples of this utter want of common sense. Only a few days ago, I heard of a lady selecting a carpet, and, when told that the particular pattern was ugly in design, quietly remarking, "Ah! well, you know, all the ugly patterns are the fashion now." Nonsense such as this, only shows the gross ignorance and conceit of a large proportion of the public, and the influence of the so-called schools of ignorant decorators, whose dogmas lead to the endless vulgarity and ignorance of much modern decoration and furniture.

Why cannot people understand that good taste and simplicity go hand in hand with common sense, while eccentricities and extravagancies of all kinds are not only vulgar, but senseless, leading to all kinds of excesses, and utterly at variance with the better instincts of human nature.

"I know what I like," is a common phrase; but with all due respect, I unhesitatingly assert that very few people do know what they like in matters of household taste, and are led into constant changes and expenses by the want of that common sense which, in other matters of life, they may possibly possess.

In furniture for every-day houses we want, first of all, that everything shall be fitted for its purpose, shall not be extravagant in design, shall be absolutely useful, and, if it be a chair or couch, absolutely comfortable. Cabinets are made to hold collections of china, and other artistic objects; what need, therefore, that the case which contains these be elaborately carved and gilt, and finished with endless rows of tiny turned ballusters, utterly useless, but exceedingly costly.

Simple framework is all that is required, with glass enclosing doors, to protect the objects from dust; but let the framework be as unpretentious as possible, and not heavy and extravagant in elaboration, moulding, or carving, utterly out of place and character with its purpose.

Tables should be strong and well-made, of good seasoned wood, the legs plainly and inexpensively turned, and not curved into absurdly contorted forms. All elaboration of carving and moulding is utterly thrown away in the legs of a chair or table, which are, as a rule, hidden from view. Care should be taken that the table legs should be set well back, so as not to interfere with the comfort of those whose place may be opposite to them. As a rule, the present telescopic arrangement of the dining-room table is most suitable for modern requirements, it will fold up to a moderate table for four people, or will expand for twenty, or even more. I cannot accept the theories of those who ask us to adopt the old-fashioned long framed table, which may yet be seen in many an old hall in England. We cannot have them made in sets of various sizes to suit different requirements, and a table that would hold even twelve would be absurd, as a general rule, in any moderated-sized dining-room. It is this kind of crazing after old-fashioned things, without discriminating as to what to take and what to avoid, which sets so many sensible people against all ancient forms and examples.

Chairs should be, first of all, comfortable, made to the shape of the back, strong and sound in construction, with no projecting carving or bossed out ornament to torture the back, and no lines of jagged brass-headed pins to catch and tear ladies' dresses. Chairs and couches should be comfortably stuffed, and luxurious in breadth of surface for rest and ease, not cramped and stiff, after the manner of the designs of some of our so-called advanced schools of furniture designers. Easy chairs should mean easy chairs, and not the miserable shams in which you cannot sit or rest with comfort. All these kind of couches may be made at moderate cost, providing you do not ask for elaborate turned wood framing, which not only adds materially to the cost, but detracts from the comfort and convenience of the piece of furniture. We don't want sideboards made in imitation of a classic shrine, with wine coolers made after the manner of Grecian sarcophagi.

If the public will only be content to make their houses simple and plain, instead of overloading them with heavy and costly furniture—generally not only uncomfortable and expensive, but utterly stiff and at variance with any home-like feelings of comfort and ease—we might hope that true art would find a place in all our homes, and, as a writer on "Household Taste," some few years ago, in *Blackwood's Magazine*, aptly wrote:—

> "If a man, in the adorning and ordering of his house, would bring a few grains of the common sense which serves him so well in the counting-house, then, at all events, might we hope to see banished from the hall, the dining-room, and the drawing-room, those vulgarities, absurdities, monstrosities, which so often outrage well-balanced judgment, and sin against sober taste. When purchasers abound in money, and manufacturers have no higher ends than trade, it is to be feared that the virtue of simplicity will in vain make her voice heard in our dwellings."

The dining-rooms of many London houses are arranged with recesses in one end or side, in which obviously it is suggested that the sideboard shall be placed; until quite recently these so-called "sideboards," or "buffets," consisted of two flanking cupboards, with an open central space for a wine cooler, a heavy dresser top, with two or three drawers, often made with bulbous and flowing fronts, suggestive of after-dinner effects anything but pleasant, and the whole surmounted by an enormous glass, enclosed within a heavy frame, twisted and curled and carved into many curious forms.

The art was bad, the construction worse, the expense enormous, and the arrangement or fitting-up for practical purposes anything but satisfactory; the usual cellaret in one cupboard was so divided that the bottles and decanters wobbled about in them, to their own imminent risk of breakage, and certain shaking-up of their contents; the shelves were so divided that too much space was left for some, and not nearly enough for other articles usually stowed away in such places; the drawer space was utterly wasted, and little or no thought was taken that the sideboard should be fitted up for its particular purpose and use, in accordance with the requirements of an ordinary household.

This sketch of an ordinary dining-room sideboard is no exaggeration. Such pieces of furniture still exist in many modern houses; nor can I see that any great amount of improvement has been made in late years in this essentially necessary part of the furniture of a dining-room. It is true that there has been much greater elaboration in the designs

of sideboards or buffets; carving, turning, and "ballustrading"—I use the term to represent the little balconies of tiny columns with which so many of the new designs are embellished—have been amplified; panels have been gorgeously inlaid; and the cost has increased in proportion, so that any really good buffet will cost from £50 to £100 at least.

Instead, therefore, of all this piling up of costly ornamentation and construction, I submit that as a buffet or "dressoir" is practically for use, and not for show, except for that of plate, or valuable china and glass, the general design might be very much simplified, and that a good useful piece of furniture, combining the requisite cupboards, cellarets, and drawers, properly arranged for their several purposes, with a moderate sized venetian glass in the centre of the back, flanked by carefully arranged shelves, and glass enclosed cupboards, for holding china and venetian glass, for show or use, might be made of mahogany, wainscot, or deal painted, free from elaborate mouldings, turning, or carving, but good in form and general design, for a considerably less sum than that charged for any moderate sized sideboard by any really good manufacturer.

How many professional men are there in town, who use their dining-rooms for professional purposes during the day, and who would gladly have some piece of furniture that should answer for the double purpose of putting away books, drawings, engravings, photographs, or papers, and for the general dining-room use? How much better, therefore, would it be for anyone, to whom a piece of furniture having this double use would be invaluable, to state his special requirements, and have a piece of furniture designed for the purpose, rather than to hastily purchase that which, in too many instances, answers neither purpose quite satisfactorily.

Buffets containing drawers for engravings or photographs, cellaret for wine, cupboards, and fittings, and dresser accommodation, for all the necessary dining-room paraphernalia, with shelves or cupboards over, for good china and glass, might be made quite as artistic, and much more inexpensively than the elaborate productions which we see now-a-days in so many modern dining-rooms.

Serving hatches from the small back rooms, or light lifts from the basement, might be equally well incorporated in the buffet, and thus we should obtain an eminently useful piece of furniture, adapted for the work of the day as well as that of the evening.

Window openings are not half utilised, as a rule, in sitting-rooms; the space is very often filled up by a chair, or small table, altogether in the way; in these window recesses might be made comfortable seats, or divans, amply and fully stuffed for ease and comfort, covered with leather or stuff, to harmonise with the other work in the rooms; and the seat inside might be fitted up for newspapers or magazines; or in the bedrooms, for clothes, bonnets, or any other special purpose for which they might be desired.

Plain deal-framed seats and risers are all that are required, properly stuffed and covered; any good joiner or upholsterer would make these at a very moderate cost, and provide you with not only comfortable seats, but useful spaces for stowing away and preserving all sorts of things, for which it is often so difficult to find room in a London house of ordinary dimensions.

In the recesses of the bedrooms might be arranged hanging closets for dresses, with shelves for linen, boxes for boots and bonnets, and the numerous articles of dress which necessarily accumulate in an English household, where we have to provide for all sorts of seasons, and can hardly ever be sure of whether we want spring, summer, or winter clothing. A simple deal panelled cupboard front is all that is required; the centre panel might be filled in with looking glass down to the ground, like an ordinary wardrobe, the doors divided, so as not to be cumbrous or heavy, the whole height of the cupboard being from seven to eight feet, including the bonnet or boot box at the bottom and the shelf at the top. Between the top of this and the ceiling the space should be filled up with a smaller cupboard, with shelves for stowing away surplus clothes and linen; but I need hardly suggest a use for any cupboards or shelves; the ladies of the house will, I am sure, not think my suggestions useless. My object in filling up the top space is that there shall be no broad surface, such as that left at the top of ordinary wardrobes, which are seldom or ever really dusted, for the accumulation of unhealthy dust and dirt. I ask any of you present this evening to examine the tops of any of your wardrobes or bookcases when you get home, and, if you are not somewhat astonished with what you will find, I will confess my error in thus strongly objecting to what I call traps for dirt and disease.

I might suggest innumerable other ways of adapting what I call construction furniture for the various rooms in a London house, such as can be made at comparatively small cost. The cupboard fronts I have here suggested could be done in deal, painted, for a few pounds; the cost of the inside fittings, of course, would vary according to what was required, but with a little thought, and a little care, all this kind of constructive furniture may be made artistic in character, easily removed, eminently useful, and withal inexpensive.

The additional labour involved in most houses to the servants, of carrying water from the basement to the upper floors, or even from one floor to another, may be greatly avoided by the more general use of fitted lavatories in the bed and dressing-rooms. With these, a constant supply of water can be obtained at any moment, and the evils of broken crockery, and water tepid from long standing, will be avoided. This arrangement must not, for a moment, be thought of unless the waste-pipes can be carried right away, so as to empty freely into the open air, and quite disconnected from any drains.

The first expense is a trifle greater that of good washstands and expensive services of crockery, but the comfort, not to say the luxury, of good cold water in constant supply in ample basins, is worth all the extra cost, to say nothing of the saving of labour in the house, and the constant expense of making good broken crockery. These basins can be fitted with a plain marble-top, sunk for brushes and the other necessaries of the toilet, and fitted under with a small enclosing cupboard, which can be provided with racks or shelves for boots and

shoes, articles of dress usually difficult to place away in ordinary dressing-rooms.

The mantelpieces of most of the modern London houses are generally of the most commonplace character, abominable in design and construction—perhaps black marble, with enormous trusses, in the dining-room, bad in form, in outline, and construction; in the drawing-room of similar character, but of white or veined marble. To leave these as they are, would utterly destroy all decorative effect in a room; when everything else looked well, they would remain as plague spots, on which the eye would continually rest. If I advocate their removal, I shall be told that I am going away from my first principles of economy, but at the risk of this, I would say, get rid of them at once. Take them down carefully, and take out the grates, and stow them all away in some cellar, where they can be brought to light and refixed when your lease is up, and any new mantelpiece that you may put up can be fixed as a piece of furniture, so as to be taken down and removed without damage to the walls.

In many of the houses of the date of the brothers Adam, and even in some of those built in the early part of this century, there remain mantelpieces and grates of good design and proportion, in which the adaptation of good Greek forms and detail, with delicate inlays of rare marbles, or gracefully sculptured panels and enrichments, are well and carefully carried out; these, of course, are invaluable.

The simpler mantelpieces of the periods I have named, in plain painted deal, with well-proportioned mouldings, and delicately modelled enrichments and figure panels, after Flaxman, are very simple in their way, and in nowise come under the category of the modern abominations of what are called "box marble mantles," in which form, detail, moulding, and carving are all execrable.

In olden days, the mantelpieces were, as a rule, the most important features in a room, carved with many a quaint device, blazoned with heraldic decoration, or filled with subject panels, exquisitely wrought and moulded, or with painting and carving, in which the highest skill of the sculptor and painter were brought into association with the designer's skill. They thus became grand and imposing features in the banqueting-hall or lady's chamber, objects of art and beauty, setting forth the cultured taste and refinement of the artists of past generations, and teaching us lessons of skill and grace in design and detail which we may well and wisely take to heart.

I need but refer you to the many exquisite examples of old mediæval work, built up with the walls which still remain to us in many old houses in England and abroad, with their deeply recessed chimney corners, pleasant places for after dinner rest; or to the examples of later days in some of the old mansions of England, all exquisitely designed with various marbles inlaid and sculptured; or to the more elaborate, but equally beautiful, structures of carved and panelled wainscot, with quaint panelling, curiously wrought columns, and cunningly devised recesses and shelves with portraits or other good work of the painter's art enframed in well-wrought mouldings in the central spaces, like some of those in Hatfield-house and Hampton-court Palace.

In fine, mantelpieces were works of art in the room, the centre to which all other panelling and decoration led up. The grates of the more important rooms were massive, with wrought or cast dogs of good design, backs cast with some figure subjects in bold relief, all grateful and pleasant to look at through the cheery blaze and sparkle of burning logs.

What a painful contrast do the machine-made modern ones of to-day offer to us, in which there is utter want of taste and design.

The mantelpiece, then, should be an important feature in any room. In the dining-room it may be of unpolished wainscot, mahogany, or American walnut, or painted deal, with a lining of black or golden Sienna marble; the lower panels may be filled in with good painted subject tiles, or delicate carving of fruit, the main shelf sufficiently broad to take, if necessary, the various ornaments, useful or otherwise, which are wanted, with perhaps a centre panel for a good portrait or subject picture, enframed in boldly carved moulding; round it, on either side, might be plain panelling, carried up to the ceiling line, with recesses for sculpture or bronzes, or tiers of shelves, for those whose tastes lie in china or other *bric-à-brac*, the top perhaps finished with a bold curved cove, filled in with stamped leather, or decorative enrichment.

For the drawing-room and library I would suggest designed mantels of similar character, but carried out to meet the special requirements of the two rooms; in the one might be subdued delicate embroidery, painted tiles, or Japanese lacquer panels, with recessed shelves lined with velvet, to set off the china or glass, the sides formed into groups of useful shelves or brackets, and the centre filled with a splayed Venetian glass, of not too great a height from the ground to be rendered useless, and of sufficient size to reflect the works of art in the room, and thus add to its cheerfulness and charm.

In the library, I would arrange small flanking cupboards for cigars or for tobacco for those who smoke, with shelves for china or books, to carry on the general furniture of the room, so that the mantelpiece should not appear as the one break in the line. But, above all, please to understand that these mantelpieces should be designed so as to be not mere objects of ornament, but absolutely useful as pieces of furniture. Why should not flanking cupboards be provided, as I have shown in one of the sketches on the wall, for guns, swords, and fishing-rods, and the various paraphernalia of a sportsman or of a soldier. If the cupboards be made air and dust-tight, all these belongings, which, to their detriment, are generally stowed away in cases and cupboards, may be kept more carefully, and add materially to the general appearance of the room, giving it at once an air of use as well as of comfort.

Many of you do not hesitate to spend twenty to a hundred pounds on a picture or piece of china, which while of course beautiful in itself, cannot give you half the pleasure, half the variety, as the same sum of money spent on a really good mantelpiece. From twenty to thirty pounds you may have a mantelpiece which shall not only be beautiful but useful, and which shall not be at variance with, but be one of the best pieces of furniture in your room, in which works of art

in the shape of well-drawn figure tiles, some delicate piece of terra-cotta modelling, some careful piece of wood carving, a small but useful Venetian mirror, or some other work of art shall be enframed.

For fifty or sixty pounds you may get a really good mantelpiece, the fireplace lined with tiles of good design, and a dog-grate that shall burn coals or wood in the winter, or be fitted to hold flowers in the summer time; and for almost the price of an ordinary marble mantel, you may in your bedrooms get one of painted deal, with art tiles that will not offend the eye whenever you look upon them. I have made a variety of sketches of mantels, which are hung on the walls, and which will to a certain extent illustrate this portion of my lecture, all of these have been executed at a cost varying from £20 to £60, inclusive of glasses, grates, and tiles, the more elaborate examples having been executed in wainscot, mahogany, and American walnut; but by using plain deal or pine, painted and varnished, a considerable saving of expense might be made. I do not offer them as designs to be accepted by you, but simply as examples of my views of the general treatment of ordinary mantelpieces.

One of the designs is by Mr. E. W. Godwin, an artist who has helped materially to improve the taste in design and colour of modern furniture and decoration. Another of the sketches shows an arrangement of cupboards and shelves which I have adapted for guns, fishing-rods, and swords, cigars, tobacco, and pipes in my own library. This work was done in deal, painted at a moderate cost, the tiles and figure plaques after Teniers being from an old German stove, and utterly unseen until placed as I have shown. The whole work was executed for me by an ordinary builder, and fitted over the existing mantelpiece, which, fortunately, happens to be of simple and fairly good design, the house having been originally designed by an architect, and not by a speculative builder.

In the smaller bedrooms or dressing-rooms, where space is not over ample, I see no reason why the mantelpiece should not, to a certain extent, be formed into a sort of dressing-table. Above the shelf, which adapts itself easily for all dressing paraphernalia, on either side, might be formed small cupboards, useful for many purposes, the centre spaces between, being filled up by a sufficiently large looking-glass, flanked with light moveable brackets for gas or candles, the whole made of deal stained and polished, or painted and varnished, or of some other inexpensive wood.

An arrangement of this kind would naturally not be suitable for the more important work of a lady's toilet; but in small bachelor or dressing-rooms, it would, I venture to think, be found sufficient for all purposes, and infinitely better than the moveable table, which generally occupies the whole window space, the white dressing-table cover of which, however charming it may be when first put on, too soon gets smeared and spotted with the blacks and dust which blow in whenever the window is opened, or find their way mysteriously but surely through cracks and crevices, one knows not how, to the certain ruin, as regards cleanliness, of everything within their reach.

In ordinary bedrooms, a plain deal painted and varnished mantel can be put up at a very small expense; as an example of what may be done in this way, Messrs. Longden and Co., of Sheffield, have sent me a simple bedroom chimney piece, made by them from the designs of a well-known architect, in deal, red-lacquer painted, with grate, fire-lamps and tiles, the total cost of which is £4 17s. inclusive, the mantelpiece itself, with tiles, costing £3 2s., and the grate £1 15s. You are not obliged to keep to this design or this colouring, but I submit this special mantelpiece as an example of what can be done in simple mantelpieces for any room in the house for an exceedingly small cost. In the hall, this kind of simple design, with cupboards over, fitted up for gloves and brushes, and with a lining of tiles, which can be obtained of good design and colour for 1s. each at Messrs. Minton or other manufacturers, would be a pleasant and useful feature of the generally dreary entrance of a London house.

If you do not wish, for various reasons, to remove the existing grates and mantels of your house, you can adapt some design for fitting up over the old mantels some useful piece of furniture, at a small cost, and thus improve the general effect of your rooms without interference with existing arrangements, and without adopting the commonplace, tasteless, and eminently dirty alternative of a wooden mantelboard, covered with velvet or cloth, with senseless and useless fringe, recommended by some of the authors of a late series of pamphlets, on what was, I think, miscalled "Art at Home."

In the increased use of painted tiles in the decoration and furniture of our houses, we are practically doing good to a large number of ladies, anxious and willing to find some means of livelihood; the painting of tiles is eminently a work for their light hands, and the good taste which most educated ladies possess, will suggest many ways of adapting the simplest flowers of the field in proper decorative treatment and ornamentation of tiles.

Before leaving the subject of fireplaces, let me say a few words about grates and fenders. As a rule, nothing can be worse in taste and design than these; the grates are not only hideous in shape, but in the better rooms of the house, are often of burnished steel with laid on ormolu mouldings, all necessitating a large amount of time and labour in keeping bright and clean. As a rule, these grates are as extravagant as they are ugly, consuming a maximum quantity of coal, and giving out a minimum amount of heat; as a consequence, all kinds of attempts are made to diminish the consumption and increase the heat, by inserting fire lump sides or balls, and putting in iron false bottoms; all these makeshifts are unsatisfactory. There is no reason why you should not have good artistic grates, combined with a maximum amount of heat from the coal consumed; and if the room be large, and access can be got to the external air, by means of many of the now well-known ventilating grates, pure warmed fresh air can be supplied at will, to add to the warmth and comfort of the rooms, at a comparatively small expense.

The slow combustion grates are now well known, and need no words of mine to recommend their adoption. Those made by Messrs. Barnard, at Norwich, designed by Mr. Jekyll, the architect, are not only exceedingly good in their artistic treat-

ment, but also in their construction and scientific arrangement for throwing out the greatest amount of heat at the smallest expenditure of coal. They consist of a plain cast ornamental front, with fire-lump back, sides, and bottom, by which the heat of the fire is retained and cast out into the room, instead of, as a rule, going up the chimney. The fire space is made as small as possible, consistent with the requirements of the grate; and by the use of tiles, the whole effect of these grates, and of others of similar character and design, made by other equally good manufacturers, is eminently pleasant and artistic, and the cost is exceedingly moderate; good grates of artistic design being obtainable at prices varying from 25s. to 50s. each, according to the size of the room and the space required to be heated; the tiles and fixing, including taking out the old stove, would cost probably an equal amount of money, so that from 50s. to £5 a good useful and artistic grate may be obtained for any room in the house; and I venture to say that the saving in price, labour of cleaning, and consumption of coal, would amply repay the cost of the new grate in the length of an ordinary lease of seven years, so that, even if you treat the new work as a fixture to be given to your landlord, you will have recouped yourself the original cost, in addition to the pleasure and charm of not only having an unartistic grate in appearance, but one which will add extra warmth and comfort to your rooms. These grates are now made by a number of the best manufacturers, and if the simple iron fronts are too plain for you, they can be obtained in bronze or brass at, of course, an increased cost; and good pattern tiles can got for filling up the sides from 1s. to 5s. each.

I have before mentioned the grate lent me by Messrs. Longden as good in design and cheap in price; the same firm have lent me two basket-grates, both of fair artistic design and moderate cost, suitable for dining or drawing-rooms. Dog-grates now made cost no more than the usual elaborate bright steel and ormolu drawing-room grates, and are eminently adapted for the dining or drawing-room, burning either wood or coal, and in all respects more artistic, and more comfortable from the extra warmth they throw out, than the old-fashioned grates I have referred to; the openings of the existing fireplaces can be easily altered to suit any of these kind of grates, and if lined all round with plain, red, or other tiles, the effect in the room will be pleasant and artistic, and the tiles, by reflecting the heat, will add much to the warmth and comfort of the room, while in the summer time the grate might be removed, and the space filled up with ferns and flowers. In my own house I have adopted this kind of fireplace and grate for my drawing-rooms, and am quite satisfied with the result, from an artistic, useful, and economical point of view. I do not hesitate, therefore, to advise the substitution of the grates I have referred to, for the general bad and extravagant examples to be found in most London houses, without fear of being told that I am departing from my first principles of usefulness, simplicity, and moderation of cost. The examples of old Sussex cast-iron backs, still left to us, can be easily fitted with a plain iron basket, these backs, as a rule, being admirable examples of low relief cast ornament, generally good in artistic design and treatment.

Amongst the general articles of furniture associated with modern fireplaces, nothing can be worse than the hideous and common-place fenders of cast-iron or burnished steel, with ormolu enrichments laid on, and which are either constantly coming unscrewed, or offering traps for the destruction of ladies' dresses by their projecting points and so-called ornaments; beyond all this, they are a constant source of annoyance, by collecting dust and dirt in their scroll-pattern angles, and under the raised iron or steel bottoms. They are, if of steel, elaborately burnished and chased, eminently costly, and involve a large expenditure of time and trouble, equally with the grate of similar character, to keep clean. My advice to you is to get rid of them at once, sell them for what they will fetch, and, in lieu of what at its best is a clumsy and inartistic protection from the falling cinders and hot ashes, substitute plain polished marble or hard stone fenders. These can be made at prices varying from 50s. to £5 or £6, are for all practical purposes better than the miserable iron or steel fenders, are not likely to get in the way of dresses, with ordinary fair treatment are not likely to get chipped or broken, and are much more pleasant and artistic to look at. Only take care that they are not made of the usual section, that is to say, with a face at right angles to the hearth, rendering it difficult to properly brush out the dust and dirt from the angles. Let the section be curved or splayed down gradually to the hearth surface, so as to, in fact, form only a moulded frame, without offering any corners or right angles for the collection of dirt.

Fire-irons should be as plain as possible, their purpose being eminently for use, not show, and these can lie either on the marble fender or on plain simple moveable stands, and are better than all the twisted forms, and all the pierced pattern abominations, which make up the general Birmingham patterns of these necessary articles of furniture.

If you object to marble or stone fenders, I suggest that, instead of all the bad cast-iron and ormolu ornamentation, you should have a simply designed high fender, say two feet high, made of plain wrought-iron bars, and filled in with pierced brass work, by which means you will obtain not only additional protection, but in part a useful screen from the fire.

If only an additional protection be required, I suggest a moveable screen about two feet high, made with a plain polished wrought-iron or steel frame, with good ornamental terminals, and filled in with brass or steel wire netting, to stand inside the marble fender. In this way protection is obtained from the fire surface in the grate, without materially interfering with the heat thrown into the room.

In this, my third lecture, I have endeavoured to throw out some suggestions for obtaining art furniture suitable for modern uses, modern requirements, and moderate purses, and to insist that the aim of all true artists should be to produce furniture at a moderate cost, beautiful in design, detail, and form, for every-day use. It is not necessary for you to enter into the theories and speculations of all the various art teachers of the day, or to follow in the footsteps of those who, in

the shortness of a life, change from Classic to Gothic, from Gothic to Queen Anne. You will be bewildered by the various enunciated opinions of a host of rival artistic authorities, all advocating the infallibility of their own particular theories on art and its accessories. It is, perhaps, unfortunate that the professors of the master arts of architecture and painting should have, in the last half century, by constant change of fashion, and so-called revival of different schools, set an example of uncertainty and dogmatism which naturally bewilder the onlooker. As a writer in a recent number of the *Times* very truly said:—

"Incredulity naturally supervenes, when our guides only serve to show us how to abandon one standard of beauty and take up with another, for the mind of the ordinary man is not nimble enough to live in a few years through as many centuries."

Now, therefore, that the best of our cabinet-makers have, for the most part, shown a desire to substitute general simplicity of form and detail for extravagance and eccentricity of design and construction, let us hope that, in their conscientious endeavours to produce things artistic, they will, in the general articles of domestic use, seek to combine comfort and utility with soundness of construction, simplicity of design, and moderation of cost. May I say to you who have so patiently listened to my address, that everything in your houses should first of all be "fitted for a place, and subordinate for a purpose," all forming part of a great and harmonious whole, in companionship and accord, not in opposition and discord, with the beautiful things with which so many of you delight to fill your houses; and that in thus making them beautiful and attractive, you are inperceptibly exercising an influence for good and upon all who see them stronger than any words. Thus the teaching of the art-work in your homes will speak in language at once powerful intelligible to your fellow-workers in the world, who will remember and delight in the work which your loving thought and care have placed around them, for long years after you perhaps have sunk into the oblivion of the past.

CORRESPONDENCE.

MILITARY DRILL AND COOKERY.

The following passages show what the Education Code prescribes respecting Military Drill and Cookery. The first passage is partly in the body of the Code and partly given as an explanatory footnote. It is not clear. Is it to be understood as authorising the whole necessary payment for a teacher of drill and of cookery? In the second note (§ 24), are the two hours a-week for drill limited by the total of 40 hours in the year? Will the Education Department explain? F. S.

17th Sept., 1880.

1.—"The income of a school (§ 17, *i*), may include part of the salary of an organising teacher, or of a teacher of drill, cooking, or any other special subject." (See note to § 17, *i*, p. 7.)

2 (§ 24).—"Attendance of boys at military drill under a competent instructor, or of girls at lessons in practical cookery, approved by the inspector, may, in a day-school, be counted as school attendance for not more than 40 hours in the year, and (in the case of drill) two hours week," p. 10.

GENERAL NOTES.

Technological Examinations.—In anticipation of the publication of their Examination Programme, the City and Guilds Institute have issued a summary of the changes that will be introduced into the Programme of 1881:—1. The examination in blowpipe analysis will be discontinued. 2. The following subjects of examination will be added to the programme:—*(a)* Plumbers' work, zinc and tin-plate work; *(b)* Tools. 3. The subjects of steel and iron manufacture will, in future, form one subject. 4. The examinations will be held on two evenings instead of one, in order to give candidates an opportunity of being examined in the subjects of two allied industries. 5. Candidates who have passed in any grade, whether in the first or second thereof, will not be re-examined in the same, or in any lower grade of the same subject. 6. Candidates for the full Technological Certificate will be required to have passed the Science and Art Department's examination in the Elementary stage, at least in two instead of one of certain Science subjects to be named in the syllabus of the several Technological subjects, unless they can give such other evidence as is hereinafter mentioned, showing that they have obtained the necessary preliminary scientific knowledge. 7. The Institute will accept as evidence of the candidate's knowledge of the necessary Science subjects—(*a*) A certificate stating that the candidate has obtained a degree in Science at one of the Universities of the United Kingdom; (*b*) a certificate from a professor at one of the following institutions (the list to be added to from time to time):—Any University of the United Kingdom, the City and Guilds of London Institute, the Royal School of Mines, University College, London, King's College, London, the Yorkshire College of Science, Leeds, University College, Bristol, Mason's College, Birmingham—stating that the candidate has attended a course of instruction under a professor or professors at one of the above institutions in the Science subjects allied to the Technological subject in which the full certificate is claimed, and has passed an examination in such Science subjects satisfactory to the professor. It will be remembered that last year, when the Society of Arts transferred these examinations to the Institute, considerable alterations were made, the number of subjects being doubled. The number of subjects is the same this year as last, two having been dropped, and two added.

Triplicate Marseilles and Algiers Cable.—The ss. *Dacia*, belonging to the India-rubber, Gutta-percha, and Telegraph Works Company, is now in the Mediterranean, employed in laying a third cable for the French Government between Marseilles and Algiers. The expedition is under the charge of Mr. R. K. Gray, engineer to the India-rubber Company. The ship carries two electric lights, the current being supplied by two Gramme machines, worked by two separate engines. These lights light the deck for paying out, picking up, and sounding. Regnier lamps are carried for lighting the tanks. A sounding wire apparatus, with improved self-adjusting break, is fixed permanently at the taffrail, on the starboard side, the cable stern sheave being on the port side. The machine is driven by a small engine fixed close to it, and connected by driving wheels with vulcanised india-rubber tires. The ship carries a buoy containing tanks filled with gas and carrying a lamp. Electric signals are fitted from bow, stern, and bridge to the engine-room and helm, and there is a system of electric bells between all the cabins, chart rooms, deck-houses and saloon, to the stewards' pantry. The arrangements show that all appliances are being tried that will facilitate the work, and thus reduce its cost. It is expected that the work will be completed, and the *Dacia* back at Silvertown, in about a month.

CONFERENCE ON PUBLIC HEALTH.

The Pamphlet containing a full report of the proceedings of the late Conference on the Progress of Public Health is now ready, price 1s.

Applications for copies of the Report should be addressed to the Secretary.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

(*The right of reproducing these lectures is reserved.*)

Lecture IV.—Delivered Monday, April 26th.

The Entrance-hall, Staircase, Dining-room, and Library.

In the present lecture, I propose offering some practical suggestions for the decoration and furniture of the entrance-hall, staircase, dining-room, and library, and to point out how they may be artistically arranged, and decorated with the materials at hand, and at little, if any, greater cost than if done in the usual tasteless manner.

The planning, arrangement, and heights of the various rooms must first of all be considered, before any opinion can be given as to the proper proportionate division of the wall spaces; various requirements need various treatments, and what may be fitted for one room may be utterly out of place in another.

As a rule, however, in the larger rooms of a house, I think it will be found desirable to break the surface of the walls, by means of divisional lines, into dados and friezes, either for useful or decorative purposes, or both.

In speaking of dados, I mean, of course, the lower space, which in olden days was represented by wood panelling, the frieze being the upper portion of the wall space next the ceiling, and what I call the general wall surface, the central space between the dado and the frieze.

In making these divisions, the general proportion and height of the particular room must, of course, be borne in mind, as well as the practical requirements; for instance, while, in my opinion, a good dado moulding or chair rail is desirable in a dining-room, to protect the painted or papered surface from being damaged by the chair backs, which are generally placed along the wall when not required for use, in a drawing-room, where the furnishing is quite of a different character, and where the lower portion of the walls is often cut up by cabinets, bookcases, and couches, a low dado would, as a rule, be out of place, as materially interfering with the lines of furniture.

A frieze, as a rule, will be found useful in every room of the house; in the reception-rooms for general decorative treatment, and in the bedrooms for plain surfaces of distemper colouring, for health's sake and economy of treatment.

The dado can be formed by means of a simple moulded deal rail, about three to four inches wide, projecting sufficiently to act as a stop to the chair backs, and fixed to the wall about 2 feet 9 inches from the floor; the frieze should be divided again from the general wall surface or central space by another flat deal rail, which need not be moulded at all, its purpose being not only to divide the frieze from the central wall space, but to act also as a picture rail or rod, from which the pictures should be suspended, instead of, as usually done, from a rod under the cornice, thus breaking the whole of the upper portion of the wall with lines of cord or wire, which are always ugly, in the way, and utterly unnecessary. Either of these rails can be put up at the cost of a few pence per foot run, and both will be found essentially useful as well as ornamental, the one for a protection to the walls, the other for hanging pictures and other works of art.

I have purposely given to these papers the distinctive title of "Town Houses," because, although many of my remarks will naturally apply to houses in the country, the planning of town houses must of necessity be totally different.

The general arrangement consists, as a rule, of a narrow entrance-hall, widened out to make room for the staircase, which stares you in the face as you enter, two or more rooms on a floor, lighted from back or front. The external architecture is, probably, of very commonplace character, generally dressed up in miserable cement imitation of stone, with stuck-on ornaments of the worst possible character.

Internally, the rooms are, as a rule, without bays or recesses, with flat ceilings, cornices of the usual stereotyped form, mantels and grates of no particular design, the former heavy with gigantic trusses, the latter resplendent with burnished steel and ormolu.

The doors are four panel, with weedy-looking mouldings; the windows filled with plate-glass, and the general lines and details of the rooms suggestive of anything but harmonious decoration. The clauses of the everyday lease, which necessitate the painting, papering, and whitewashing once within a certain period, will enable you, if you will, to substitute artistic for commonplace decoration; to hang your walls, and paint your doors and other woodwork, at little or no greater cost than that of the flock or moiré papers and imitation graining so much affected in later years; while the change in carpets, hangings, and furniture, rendered necessary by wear and tear, will enable you to replace the bad and ugly with what shall be in good taste and pleasant to look upon, or at least inoffensive. Depend upon it, the first really beautiful thing you buy—whether it be an inlaid cabinet, a picture, or a piece of painted china—with a real appreciation and love for it as a work of art, and that to you, "as a thing of beauty it is joy for ever," will be the commencement of an art teaching which will eventually lead you to discard what you formerly

looked upon as fitting; and, the eye once educated, will make you surround yourselves with only those things which shall have some beauty of form or colour. I cannot understand how anyone who truly appreciates a beatiful painting, piece of sculpture, or drawing, can conscientiously, or with any pleasure, permit in the same room other elements which are absolutely not only incongruous, but ugly; not only unartistic, but vulgar and commonplace. I can, of course, understand, although I cannot appreciate, the pride which desires simply to express power of wealth in valuable paintings; but I cannot believe there can be any real love for the art expressed in them, or just appreciation of their distinctive merits, if all the surroundings are commonplace and inharmonious.

Before discussing the special arrangement of individual rooms, let me say something about the cost of the various modes of decoration I propose to recommend, and of their special application.

A few general hints as to paint, paper, and distemper work, will assist you in arriving at something like the cost of the work you propose to do, and in your dealings with the workman you may employ. A little knowledge is said to be a dangerous thing, but I fancy that if you can show that you know something about the proper cost of papering, painting, and distempering, you will be in a better position to decide as to what shall be done, and how far the means at your disposal will admit of any higher class of decoration in any of your rooms.

English papers differ from French, by being made 21 inches instead of 18 inches in width, and with twelve instead of nine yards in each piece, so that a piece of English paper of 12 yards in length will cover seven square yards of wall surface, as against four and a half square yards of French. The cost of hanging ordinary papers varies from 1s. to 1s. 6d. per piece, increasing to 2s. and 2s. 6d. per piece for better class papers, in which there is much gold—a greater amount of care and time being required for these—to 4s. and 5s. per piece for flock-papers, all of which have to be trimmed with a knife, a much longer proceeding than the usual one of trimming the edges, or cutting off the waste pieces, with a pair of scissors.

Lining papers, for walls and ceilings, cost from 2s. to 2s. 6d. a piece, hung complete. These, as a rule, are only necessary where the general surface of the walls is very rough and uneven, and where it is intended to paint or distemper the whole surface; and in ceilings where the plaster work is bad or defective or much cracked, the cost of what is technically called "washing and stopping," which means cleaning off the old distemper, and cutting out, fillir g in, and rubbing down all cracks in old ceilings, must depend very much upon how much of this making good has to be done; but with ordinary walls or ceilings, the cost of this, including plain sizing and distempering, varies from 3d. to 6d. per square yard, all stencil decoration and picking in of cornices with colours, involving, of course, extra expense.

The cost of plain painting to walls, and bringing them up to a good surface in three or four coats, varies from 1s. 9d. to 2s. 3d. a yard, with an extra 1s. a yard for varnishing. As a rule, few old walls will stand being varnished, the finishing of the plaster-work not being sufficiently smooth or level, for it must be remembered that varnish brings out all imperfections in a most decisive manner.

The cost of stopping and plain painting in three or four coats, for the margins or general surfaces of floors, varies from 1s. 6d. to 2s. a yard, finished complete; while the cost of the cheapest ordinary Brussels carpet, $\frac{3}{4}$ of a yard wide only, is at least 5s. 6d. per yard run, or practically nearly 7s. a square yard, exclusive of making; you will see, therefore, that, in strongly advocating painted borders as more healthy and artistic, I am advocating a treatment of floor surfaces infinitely less expensive than covering them with carpets.

Japanning or lacquer painting is a term applied to painting, in which varnish, to a large extent, forms the vehicle or medium with which the colour is mixed. This, when properly done, produces an appearance of a lacquered or polished surface, and can be applied to all kinds of furniture, made of cheap woods, with good effect, at about one-third extra cost over that of plain painting.

In enamelling woodwork, this kind of varnish paint is used, but the work is carefully rubbed down after each coat, and much labour is required to bring the ultimate result to the enamel-like effect of good coach painting; this kind of work is necessarily expensive, and the result not always satisfactory.

It is well to remember that different materials need different treatments, and much depends on the nature and appearance of the work to be painted; delicate tints require colourless oil for their vehicle; surfaces required to be finished in flat must have little or no oil at all, as the use of it necessarily imparts a gloss and shining surface, which, in flatted work, is to be avoided; paint mixed with turpentine is not nearly as lasting as that mixed with oil, but a little turps is necessary in all work exposed to the sun, either inside or out, to prevent the paint from blistering, and, as a rule, where you find shutter fronts and other painting in the window openings blistered, you may be sure that the work has been improperly done. The silicate paints now made, which for their basis have pure calcined silica, are said to stand any fair amount of heat without blistering, and, weight for weight, to cover at least a third more wall space than ordinary oil paints, both valuable recommendations for their more extensive adoption for everyday use.

I have thus briefly given you some few practical hints, which those who are about to paint or decorate will, I think, find useful. As I proceed with my lecture, I shall endeavour, as far as possible, to give some idea of the cost of the decorative treatment I suggest in the various rooms which I purpose treating of this evening, namely, the hall, staircase, dining-room, and library.

Let us suppose that the street-door—which should be painted in some warm, serviceable colour, either chocolate or brown, and varnished for protection against the weather, and to render it easily cleaned—is opened, and we are in the hall, the antechamber of the house. Here the walls should be painted with some good, serviceable colour—not too light, to show finger marks—to two-thirds of their height, with some simple pattern stencilled over the surface, but, if possible, varied—that is to say, light upon dark and dark upon light—and the whole carefully varnished, not

only to protect the paint, but to render the walls easily cleaned without damage. The stencil work may be done in a darker or lighter shade of the general tint; and here and there a panel might be formed, in which a figure might be painted in outline, or stencilled on. It is well, however, to remember that figure-work must be done by an artist who knows, from long study, how to draw the human form, for any feeble prettiness of figure-drawing, such as we see so often in the panels of modern furniture, and on tiles, is worse than nothing; and it is better to have a good conventional flower, well drawn, than any pretence of figure-work, which, after a time, when you have learnt to appreciate and know what good drawing is, will disgust you. The upper portion of the walls should be divided by a plain wood moulding, which, if desired, can be formed into a narrow shelf, on which to place light pieces of majolica or *gris de Flandres*, or other ware. Drawings, or anything hung on the walls, as a rule, are generally in the way, and are liable to blow about and damage the decorations. The space under the cornice so divided might be distempered; for where gas is used, this portion of the wall is likely to get dirty or discoloured in a year, and the distemper can be washed off or re-done at a small cost.

In the frieze might be panels containing birds and figures, which could be done in distemper with good effect, the general drawing being done in plain red outline, contrasting well with a cream-coloured general tone of ground. Panels of figure tiles, which last for ever, or a plain running stencil pattern of foliage, shields, and birds, as an enriched border just below the cornice, might be judiciously introduced, or a good light toned and simple pattern, or stamped paper, such as those I described in my second lecture, may be hung over the whole space instead of distemper. This stencil decoration may be done very inexpensively, for when once the patterns are cut out—and these may be as many or as few as you like—the mere skill and labour required are of very ordinary kind for simple work of this description. Decorative wreaths of one or two colours, and pots of flowers or foliage sufficiently large to form a good decorative frieze in distemper colouring, may be done from 2s. 6d. to 3s. 6d. a yard run, and the patterns may be kept, so that the work may be renewed, if necessary, each year, or changed with new patterns, which can be cut out at a very small expenditure of time and money. The ceiling should be lightly tinted in a vellum, pink, or grey tone, with some slight stencil decoration to relieve it, and the cornice treated in very light shades in distemper.

Remember these ceilings are certain in a little space to get dingy from London atmosphere, and the wretched impurities of London gas. (I suppose we shall never have pure gas until all the directors of the companies are suffocated in their own gasometers, and some few people's livelihood made dependent upon the quality of the gas supplied.) At a little extra cost, plain deal or canvas plaster ribs might be laid over the existing plaster work, and the panels thus formed could be filled in with good flock paper, to take away the general flatness of the surface, and could be painted whenever required; or the whole surface may be covered with canvas plaster, in a delicate all-over pattern of naturalistic or conventional leaf ornament, cast in low relief, the ground work being tinted golden yellow colour.

Another, but more expensive treatment of the outer hall, would be by panelling the walls six or seven feet high in plain deal, painted in red or blue lacquer colour, and with a good flock paper frieze, painted light-golden yellow, flecked with reddish or brighter golden touches, to take off from the general sameness which one tint would have, when not relieved by decoration. The use of flock or stamped papers in small friezes of this kind, especially if painted, can be used with good effect, and sometimes the pattern will permit of some particular portion of it being picked out in a a different tone of colour; but in any treatment of this kind, great care must be taken to prevent a spotty appearance.

Marble mosaic tiles may also be used with good effect on the walls of the outer hall, at a cost varying from 12s. to 20s. per square yard. The effect of these are generally satisfactory, and, the surface being polished, is easily cleaned, and is not affected by changes of weather or atmosphere. The woodwork should be painted throughout in two plain colours, with the mouldings strengthened in darker tone, and the whole varnished; if the mullions and framing of the door be done in a dark shade, let us say of brown, the panels should be lighter in tone, with stencil decoration of flowers, birds, or fruit in the darker tone of colour. Here let me say, that all woodwork, such as doors, windows, and shutters, which are subject to the wear of not always clean hands, should be varnished throughout; the extra cost of this will be saved by the increased time which the paint and decoration will stand, and plain washing, with a damp cloth or sponge, will at all times clean off any and all marks. In my own house this kind of work has stood for nearly ten years, and is to-day as fresh as when it was done. Do not be led away by the theory that varnish will destroy the delicacy of colour; of course, care must be taken in the tints you wish to arrive at, by increasing or toning the colours to meet the glaze which varnish gives. Where an inner screen is really used, that is, kept shut to keep the inner hall more private, the panels of the doors should be glazed with leaded or jewelled glass, instead of the ordinary embossed plate or enamelled sheet glass; small designs in colour can be introduced at small cost, say from 2s. to 6s. per square foot, and will add much to the cheerfulness of the hall, with the play of sunlight through the various tinted glass.

It is not necessary to say that the fashion of small or leaded panes of glass has been much abused, but in such places as hall screens, where additional privacy is desired, they may legitimately be used. To ignore the advantages of modern plate glass in ordinary windows, where light and outlook are desired, is simply ridiculous; but I see no reason why the upper portions of the windows of London houses may not have figure or flower designs, panelled or framed into smaller white-leaded panes, as in London the sky is too often of a gloomy aspect, and when the sun does pay its rare visits to our streets and squares, it will not be the less appreciated because it comes through painted glass, and adds to its charms the beauties of many glinted colours. The mantelpiece of a London hall is generally so common, and the hall

so narrow, that a shelf is almost useless. Why not, therefore, discard it altogether, and frame the grate with a border of tiles, kept in by a slight wood moulding. Messrs. Minton and Co., and other manufacturers, have numerous examples of good art tiles suitable for this purpose, from 1s. to 5s. each. If you wish for places for china, have plain painted deal shelves, made in groups, gradually diminishing from the lower to the upper shelf, and fixed above the mantelpiece. Do not, as is so often done, cover the mantelshelf with a wooden top, covered with cloth or velvet, nailed on with a fringe and brass nails; this will be an endless source of annoyance, from the fact that it never can be kept free from dirt and dust, not to say anything of its spotty and unartistic effect. There are, of course, endless other ways of decorating a hall, by panelling the lower portion with tiles or wood, and filling up above with a good pattern paper of light tone or painted decoration. Simple distemper work, if well done, may be used instead of paint, and is of course much less expensive. A good bright reddish-brown tone on the lower portion of the walls, with yellowish cream ground above, with enriched panels and cornice, can all be done in distemper, and if brushed down occasionally with a light brush, will remain good and effective for some years. As a rule, the floors of London houses are of stone, and this, if kept clean and whitened, forms a very good border for a bright Persian or Indian rug, which can now be obtained at a very moderate cost; or the stone floor may have a border of plain marble or mosaic work, such as I have described in my lecture on floor decoration. A good "Kurd" mat or rug, about six feet long, by three feet six inches wide, may be obtained for 10s. or 15s., and its bright colour gives a cheerful warm look to the hall as you enter. The door-mat should be sunk flush with the floor, and of large size, so that little or no dirt may be carried on the rug. "Mischiata," or marble mosaic, forms an excellent pavement, and although more expensive, is preferable to the everlasting tile floors, which have been imitated *ad nauseam* in oilcloth. If tiles are used, they should be in one good colour; say red or chocolate, with a very simple border; or white and black tiles, in two-inch squares, laid to a bold pattern, and divided into square panels, and bordered by thin black lines, look well, and are easily cleaned.

In an ordinary London hall there is not much room for furniture of any kind, but there is still space for one or two high-backed chairs of plain oak, or a long deal settle with plain rail back and elbows, and for a small stand for wet umbrellas; this latter need not be one of the usual cast-iron abominations, but can be incorporated with the seat, with a zinc tray at the bottom and a carved brass rail at top. The rush-bottomed settle lent me by Messrs. Morris would be quite good enough for any ordinary hall, and costs only 35s. complete.

If possible, in the inner hall, there should be a simple cupboard, with sliding, not folding, doors, with shelves arranged for coats, and a sliding rack forhats, a few hooks or pegs above for sticks and umbrellas, and the top may be made of unpolished oak or other hard wood, or marble, to act as a serving table.

"Portiéres" in London halls are generally objectionable, as offering traps for dirt and dust. On the landings I would have a comfortable divan or stuffed seat of the plainest description—throw a piece of coloured stuff or silk over it for colour—which will be found convenient and useful on occasions when you receive guests; at each end might be arranged receptacles for plants and flowers, which are always grateful and pleasant to look at.

A London staircase is generally a cold and dreary approach to the real withdrawing or living rooms of the house—the rooms where we receive our guests, and spend our pleasantest hours—often a long vault, walled in with blocks of imitation marble, a cold stone staircase, with cast-iron balustrading of the worst possible design—generally imitative of wrought-iron construction—thin, poor, and often unsafe, with a thin moulded handrail, with what are technically called ramps, wreaths, and curtails of the usual speculative builder's character. Of course all these must remain. We cannot exchange them for the wide oak staircase, with its boldly carved newels, handrails that look like support, and handsomely turned balusters of Elizabethan date; such, indeed, as are still left in numerous old English mansions, and in some few of the older London houses; but we can make them more cheerful, and less cold and dull. A painted and varnished dado, with a wooden moulding raking with the handrail, or plain deal painted panelling, will be at once a help and improvement. The wretched ironwork painted in a plain bright colour—not picked out in gold, to show its peculiar eccentricities and faults of design—and the thin moulding which serves as a handrail, ebonised as a contrast, will all help the peculiarly unfortunate lines on which you have to work. Above the dado, either distemper or paper in some warm and cheerful colour. If you paper, let the paper be of one general tone, otherwise the great space to be covered will be spotty and disagreeable.

As an example of paper decoration for inner halls and staircases, Messrs. Jeffrey have been good enough to send me one designed by Mr. Walter Crane, which is certainly quaint and clever in its treatment, and suitable for the purpose, although somewhat expensive. The general ground is of a soft yellow tone, with deeper toned decoration in lines and patterns, and diapered over with dark wall flowers. The upper portion or frieze has a ground of delicate blue, and is covered with pale pink almond flowers. The whole treatment is exceedingly decorative and well executed; the lower portion might be varnished, so as to be easily washed.

A good warm golden-brown or yellow forms a good general tone for a London hall and staircase, with a Pompeian red dado painted, with black skirting and rail, and a frieze of light pattern paper or cream-coloured distemper ground, with line enrichment in dark golden brown or red. The general woodwork could be painted black, where there is not too much of it, or in two shades of good red or brown; or the general tone might be peacock or light blue, with soft vellum grey and blue pattern papers or distemper. A deep frieze, of boldly designed painted or stencil ornament, will assist much in breaking the usual bad proportion of the staircase wall, while panels may be formed in bold lines of paint or distemper, wherein

may be framed pictures or other art work. A good neutral tint, or warm grey ground, with ornament in green and vermillion, has a good effect if the colours be carefully treated; or a wide diaper, with patterns interchanged, and charged with shields and legends here and there. Any good photographs, sketches, or studies are useful to hang on the rake of the staircase, on the eye line, to take off the general coldness. Many varieties of tints will suggest themselves, which will help to give a bright and cheerful character to the passage-way of the whole house, in place of the cold and dreary, rightly called, well, to which we are so accustomed. As a rule, the lower flights of a London staircase are fairly well lighted, and the walls can, therefore, be hung with drawings. If possible, put here and there a piece of china, or a good figure, on brackets, in the angles, to break the ugly appearance of the narrow half-landing. A carefully designed lantern light, filled with leaded and jewelled glass, hung from the ceiling, will cost no more than the miserably painted iron or bronzed brackets, which are generally affected, and will light the stairs more evenly. A bright drugget, nearly covering the whole of the treadway, with the stone margins treated in good warm colour to harmonise with it, is surely better than the narrow three-quarter width carpet, with its edges of cold painted stone; while here and there, on the landings and half spaces, a small Persian or Indian rug or prayer carpet—which can be bought for almost the price of the carpet usually used—will give colour and brightness, and add to the feeling of warmth and comfort; and these, always remember, can be taken up easily, and shaken, if requisite, every day, and are certainly more cleanly than the closely fastened down carpet, under which the dust accumulates and stays for many months. If the landing or half space be large, put a comfortably low couch, with some bright covering, and a stand for flowers or china; for any bit of colour, either of nature or art, will add much to the cheerfulness of this part of the house.

Now-a-days, the art of China and Japan is well known to all of us; and, although I do not for a moment advocate any imitation of Japanese work in the decoration of English houses, yet there are many things we may do well to study Japanese work for. In painting on china and faïence, in every form of decorative art, the Japanese show a keen love and an intimate knowledge of all that is best and beautiful in Nature, and are always at their best in depicting her ever-varied form, whether in flowers, tree, or animal life. With a few exquisite touches, the loveliest forms are placed before us, with great truth and freedom of drawing; and in their art there is a desire to set forth beautiful forms, and to express lovely combination of colour in ever-varying fancy. They always seem to remember that all true decoration is based on construction, that the life and flower, so to speak, of decorative work must spring from the root and framework of construction; just as a good painter will draw his figure first, before clothing it, and the trunk and branches of a tree before covering them with foliage. What can be more exquisite than some of the drawing and colouring of the innumerable paper and silk blinds and fans, that have been imported to such a large extent in the last few years? Many of these can be bought for a few shillings, and are admirable pieces of colour decoration to hang on the walls of hall or staircase, or framed in small panels round the frieze. The colouring is generally quiet and refined in treatment, and eminently decorative, and at the same time perfectly true to nature. Where an ordinary workman would conventionalise a flower or bird, and produce whole rows of them, without variation of any kind, in a stiff and unnatural manner, these Japanese artists give us endless variety and colouring, always graceful and effective, and never crude or coarse in colour. By a few touches they produce Nature in life and movement; a tree bent and shaken by the wind, a blade of grass bent or broken by some passing footstep, a spray of flowers waving with the summer breeze; birds in endless movement, flying or asleep, and all true to the characteristics of their life and form. In the lily, the carnation, convolvulus, fruit, or May blossoms, we see numerous examples of our own English flowers, depicted in a way which few artists in England can equal or excel. All such bits of decorative art can be made much of in the dull monotony of a London house, and now-a-days can be purchased at a very trifling cost. If you will only trace, or get traced, some of the outline sketches of wild fowl, cocks and hens, pheasants, or storks, you will find they can be used with good effect, as stencil decoration, for the upper portion of the staircase walls, or in smaller scale for panels of doors, shutters, and other woodwork, which, as a rule, are left untouched. For instance, suppose you have the usual four-panel doors common to most of our houses, with mouldings run round of no particular design, I would suggest that you should paint them in two shades of colour, to harmonise or contrast with the paper on the walls, the panels being the lighter shade, and on these stencil some of the designs I have alluded to in the darker shade, and then varnish the whole. By these means you will obtain, at the cost of a few shillings, a real good piece of decoration, which will always be pleasant to look at, instead of the dull monotony of imitation graining of oak, maple, or satin wood, to which we are so much accustomed. In decorative art, we have much to learn from the artists of Japan, who, for many hundreds of years seem, in their humblest articles of daily use, to have carried out some impress of their love and knowledge of Nature in her most beautiful forms.

I cannot pretend to lay down any set rule for the decoration of the principal rooms of a house, nor would I if I could. The great mistake that is made now-a-days by some professional decorators, is fixing all design and furnishing in a room to one set rule, so that you feel on entering it that everything is stiff and formal, and intended for show, not use.

I heard recently of one of these gentlemen informing a lady of excellent taste, and who had brought into her room various bits of ecclectic but useful furniture, that "had he known she was going thus to interfere with his general set scheme of decoration, he would have declined to have had anything to do with the work;" a remark at once impertinent and characteristic of the general conceit of such false teachers.

If such a room could speak, it would cry out aloud, "Look at me; am I not an art room? But please do not bring any pretty things—any books,

or any china—here, or you will disturb my propriety. I am not intended to be home-like, but artistic." In the mansions of Hatfield, Haddon, and Knowle, and many other old halls of England, the walls of the great rooms, as well as the entrances, and often the bedrooms, were panelled with oak, in small panels, to half or two-thirds of their height, and the remaining space covered with tapestry or stamped leather, and the effect of the rich brown oak walls with delicately-carved friezes, bold and well-wrought mouldings, and panelling enriched with graceful arabesque or linen-fold design, is always charming, and contrasts well with the white ceilings panelled in fretwork or geometrical patterns; with mouldings in low relief, as in the old houses lately pulled down in Lime-street; but all this kind of work is not suitable to the general rooms of a town house, where the dust and blacks of the too filthy town atmosphere find resting-places in every moulding and every bit of carving. In later days, these many panels were changed into what is called a "dado" about three feet high, panelled lengthways. Above were larger panels running the whole length of the room, or finished with a narrow carved or panelled frieze, the mouldings generally being in relief. After a time, this arrangement was found inconvenient, and the panels of the upper portion of the walls were removed, the capping of the dado being allowed to remain as a chair-rail, and this arrangement is still to be found in many London houses.

Apropos of the dust and smoke of towns. We pride ourselves on being a scientific nation, a practical and common-sense people, and withal patient and long-suffering in putting up with abuses, such as have no more right to exist than any other ills which are opposed to all laws, moral, hygienic, and otherwise. I often wonder how long we shall be content to accept gas, which, from its marvellous impurity and want of lighting power, is a disgrace to any civilised country in the world. How long we shall be content to cast out into the common air, and by our own want of sense and scientific arrangement in small matters, to sow broadcast the evils which work the destruction of everything within our homes, and cover the delicate leaves of the trees in our squares, and the flowers of the earth, with black, filthy corruption, when, I take it, it is quite possible to burn all this smoke and impurity with infinite saving of cost in fuel, and manifest gain in health, comfort, and cleanliness to ourselves. How long shall we be content to allow the water supply of our towns to be the monopoly of a few companies, who limit our supply, and increase the charges almost as they please, and, as a rule, leave us, when all is said, with water, the purity of which is uncertain; life-destroying rather than life-giving. Or how long shall we permit gas and water companies, so to arrange their mains that any repairs or alterations, as a rule, involve the taking up and destruction of our street paving, instead of their being so arranged as to be got at quickly and easily, without damage to our roads and paths? Or how long we shall be content to allow vestries and other local bodies to shut up main thoroughfares, and alter street paving in important highways and streets, to the public loss and inconvenience, in the most busy periods of the year? Or how long we shall rest content to be behind all other civilised countries in the arrangements for watering and cleansing our streets. These are matters which, however unartistic they may be in themselves, exercise a very great influence on the comfort and cleanliness of our homes and surroundings.

The French rarely or ever furnish their *salles à manger* or dining-rooms to any great extent. In England we use these rooms much more largely, and should make them as pleasant to look at as possible, care being taken not to hang the walls with tapestry, silk, or other stuffs which retain the smell of food. A painted dado of a good dark tone, with a bold chair rail to prevent the chairs from damaging the walls, is generally desirable, or plain deal painted panelling to a height of three or four feet, above which the walls may be papered or painted, to within two or three feet of the ceiling; the room, so divided, will give ample space for the hanging of pictures or prints; and instead of the ordinary picture rods under the cornice, with their long pendant lines of dusty cord or wire, cutting up the walls into endless queer and bad forms, a small moulding should be placed along the wall, under the frieze, into which hooks can be screwed and removed at will, or a light iron rod—ordinary gas piping will do—may form the lowermost moulding of this rail, on which any amount of pictures or drawings may be hung. If the wall is to form a background for pictures, a good warm brown or chocolate colour, in paint or distemper, will be found most effective. There are innumerable colours which can be adopted, but, for goodness sake, avoid the dreary commonplaceness of light apple and sage greens, which seem to be the only colours thought appropriate for dining-room walls.

The use of what is called a flatting coat, or finishing coat, of paint, mixed with turpentine only for wall surfaces, so as to produce a dull flat or dead surface without gloss, is, I think, a mistake, for this kind of work does not last when exposed to the weather; it shows every mark of dirt, and will not, as a rule, stand washing. This picture surface, if painted, should not be varnished, but the dado and all woodwork of the doors and windows will be made much more effective if varnished, as I have before recommended. The woodwork should be painted of similar colour, as a rule, to the walls, but of much darker tone, in two shades, and the panels covered with good ornament, stencilled on, all of which is inexpensive, and adds materially to the general artistic effect. The broad frieze, above what I call the picture space, should be much lighter in tone, and here of course there is an opportunity for real art-work; a broad decorative painted frieze, painted in compartments or panels, with figure subjects, is of course, to my mind, the most desirable finish.

I have already, in my second lecture, discussed this important question of high art-decoration, and I need not further refer to it except to say, that for one hundred pounds, the price of a small picture or good piece of china, you may get good painted decoration, designed and carried out by an artist, for the frieze of an ordinary dining-room, in which good figure painting, in combination with birds, foliage, or other decorative accessories, shall be carried out in oils, on canvas or panel, so as to be

removable at any time; failing this, I suggest good artistic stencil decoration in distemper or oil.

As an example of what may be done in stencil work in oil, I submit a design by Mr. George Howe, of Forest-hill; this gentleman has taken up the subject of stencil decoration, with a view to its more artistic rendering and treatment, and has educated a certain number of lads and young men under him, to treat this kind of work more as art than mere mechanical decoration, and has sought to imbue them with a proper artistic feeling for their work, so that to them it shall become a real work of art, and not a mere slavish reproduction of various cut stencil plates, in one tone or shade of colouring, and in unvaried and monotonous repetition.

In ordinary stencil decoration, the pattern is generally rubbed on in one tone of colour, and the arrangement of the design is, as a rule, a mere reproduction of parts prolonged indefinitely, according to the amount of space to be covered; in this screen of Mr. Howe's, you will notice that, instead of plain flat treatment of the stencil pattern, he has produced, by cleverness of handling and artistic touch, a varied tone in the different leaves and fruit forming the pattern, either by working the stencil brush very slightly over a portion of the leaf, and increasing the strength of touch and amount of colour in the lower portion —by which a pleasant gradation of colour is carried out—or by the use of two or more colours in the same leaf or flower, carefully blended at the moment, and worked off into delicately-shadowed surfaces, by which an extremely good effect is obtained.

The general decorative effect is still, as it should be in this kind of work, quite flat and simple; but infinitely greater artistic character is given to the work, by the skill and feeling shown in the manipulation of the brush, and in the interchange of one or two colours, to say nothing of a fairly artistic rendering and decorative treatment of the design itself, by interchanging the stencil plates, and avoiding, as far as possible, any formal repetition. I am glad to see this attempt to improve upon the ordinary mechanical work of stencilling, by making it more decorative and artistic, and to feel that there are workmen who can and will carry out, as far as practicable, the views I have so strongly advocated, of making cheap decoration artistic in character and feeling.

The men who could do the work submitted could, with a little teaching, do anything in this character of decoration, and with a little extra teaching, and study of good examples, would avoid the anachronisms and errors in design and treatment which are herein manifest, and wherein, if anything, there is too much striving after imitation of Japanese ornament, without the knowledge of the "*motif*," power of drawing, and artistic grouping, so noticeable in the work of Japanese artists. This kind of work could be produced, including the three or four coats of colour necessary for the groundwork, at from 4s. 6d. to 5s. 6d. a square yard, so that a frieze of, say, two feet deep in an ordinary room of, say, 24 by 16, after deducting the window openings, could be done for £5 or £6, about the price of good flock paper, and when done would last for 10 or 15 years at least. In all artistic work of this kind, it must always be remembered "that immoderate multiplicity fatigues the eye; that excessive copiousness causes many objects to be condemned as useless; that unity of conception, proportion of parts, and symmetry in the principal decorations are indispensable laws never to be neglected." Raphael, carried away by the exuberance of his genius, and the skill of his pupils, squandered and wasted decoration in the Vatican, and lost the chief attributes of his ancient models, simplicity and moderation in design and treatment.

In the papering of the walls of dining-rooms and libraries, there are, of course, very many ways of treatment, and amongst the numerous good examples of paper-hangings now made, there should be no difficulty in selecting some really good pattern, artistic in design and colouring. Messrs. Jeffrey have been good enough to arrange some few combinations of papers, from my suggestions, showing what can be done in the treatment of general wall surfaces. As I have before stated, I consider a dado a desirable basis for a dining-room, and a wide frieze a proper finish to the wall, instead of carrying up the general tone of colour of the walls to the ceiling or cornice line; the treatment suggests itself as infinitely better and more artistic than carrying up the same wall paper, or decoration, to the top of the room, and thus making a sudden break, without any gradation of colour between it and the ceiling. In the combinations shown, you will find the dado formed in stamped paper of dark colour, the general wall surface being treated with artistic papers of green, brown, red, and blue grounds of various shades, all adapted for back-grounds for pictures or engravings. The frieze is here shown in various coloured flock papers, of good design; the cost of these vary, the sunflower and sunflower bud flock patterns, both extremely decorative and good in colouring and design, are respectively 6s. and 5s. 6d. per yard; the plain water-colour adaptation of the same being only 1s. per yard. The "Albert Moore" pattern, either in brown and white, or blue and white, in single print, and other patterns shown, vary from 5s. to 12s. per piece; the dark dado paper (in imitation of stamped leather), costs about 5s. a yard, and the flock pattern papers, for frieze and ceilings, from 4s. to 6s. per yard; the plain ceiling patterns, in one tone of yellow or other colour diaper, vary from 2s. 6d. to 3s. 6d. per piece.

As an example of pure decorative paper of high artistic character, there is the "Mermaid" paper, designed by Mr. Walter Crane, in which the dado is treated as a pebbly beach, the general surface as water with fishes swimming in it, and the frieze as mermaids rising out of the water under. There are other good examples of papers all capable of making highly artistic wall decoration; all good in design and colouring.

In choosing paper great care should be exercised, as the colour and general appearance of most of the patterns change very greatly, under gas or candle light. It is, therefore, desirable to select three or four patterns, and put them up on the walls of the room you are intending to cover, and examine their general effect carefully, by day and night, before making a final choice; for not only do some patterns and colours materially alter by gas or candle light, but some, especially green and

blue, absorb an immense amount of light, and are, therefore, not fitted for any rooms which are not strongly lighted.

Messrs. Morris have also been good enough to send me some few combinations of papers and hangings, showing colours which contrast and harmonise well together, some of them especially good in design and colouring, and inexpensive in price; the papers varying from 5s. to 8s. per piece, and the hangings of tapestry or cretonne from 3s. to 12s. a square yard. They also, at my request, exhibit various specimens of Kidderminster and Wilton carpets adapted for the papers shown at 6s. 6d. to 10s. 6d. per square yard.

Messrs. Gillow, and Messrs. Campbell and Smith, also send me various hangings for window-curtains, of different stuffs and materials, which can be put up at a cost varying from 15s. to 15 guineas a window complete. Some of the cheaper kind of cretonne, jute, and cotton-waste hangings are not only artistic, but extremely moderate in cost, and you need have no difficulty in providing good curtains for any ordinary-sized window, from 25s. to 60s. a set complete. The Kidderminster rugs, two yards long by one yard wide, are quite good enough for any ordinary room or staircase landings, can be bought for 18s. each, are good in design and colouring, and, as I know by experience, capital rugs for wear. I have selected the various patterns of papers, stuff-hangings, and carpets, only with a view of showing you that you can obtain these from any good decorator or upholsterer at moderate prices, and to disabuse you of the idea that cheap things must necessarily be nasty.

It is unfortunate that there is not a little more common honesty amongst a certain class of manufacturers, and that they should lower themselves by stealing the designs of others in the same trade; or by bodily adapting, without leave and without payment, artists' designs which have been made to illustrate Christmas-books, or for other purposes, in no way intended for paper decoration. As an instance of this, I believe I am correct in stating that the whole of Mr. Walter Crane's admirable illustration of "The Babies' Opera" have been bodily appropriated and adapted as a design for wall paper, without permission, thanks, or recognition of any kind. All this kind of treatment is not only grossly unfair, to use the mildest possible term, but is in the highest degree discouraging to artists (whose brains and skill of design and drawing are their living), who naturally hesitate to design work of any kind, if they know that it is to be stolen and mutilated for other purposes, without recognition.

I take it this kind of treatment of artists' work is as grossly dishonourable and dishonest as appropriating any other kind of goods from another man's premises, or forging his name to a cheque, and obtaining payment of cash in change; and much as we may desire free trade in everything, I fancy all right-minded people would accept a more stringent law of protection and copyright, if only it might save us from these practices, alike dishonourable to the individual, and to the trade.

In the dining-room of the house, everything in furniture should be as comfortable and convenient as possible, designed for use, not show; the chairs should be broad-seated and backed, and strong; not narrow, high backed, and spindle legged, with knobs and irregularities to torture the back. The seats and backs should be stuffed and covered with strong serviceable leather or morocco, in preference to velvet, which is liable to hold dust and to drag the laces of ladies' dresses. Good plain chairs of unpolished wainscot or American walnut are better than any highly-polished surfaces, which show the least scratch; or deal chairs of solid design, painted and decorated in low colours, would answer equally well, and be cheaper.

I hardly like to suggest rush bottoms, lest I should be thought too archaic, but, believe me, that these are as comfortable as any leather-covered seats; and if made with various colours, pleasant to look at. In addition to the ordinary chair, I would have two comfortable arm chairs, of sufficient size, to give freedom of space for carving purposes, and perhaps one or two comfortable lounge chairs, for drawing round the fire after dinner.

The table should be so made that those who are placed at the angles are not made to suffer torture and misery during the long hours of dinner, by projecting legs, which are always in the wrong place.

I can conceive nothing more suitable or better for an ordinary room than a round table, 4 ft. 8 in. to 5 ft. in diameter, on one massive central support, the top made expanding, by some such simple contrivance as that shown in a table of the kind exhibited at Paris by a London firm, into almost any length, so as to form, when open, an elongated oval. Avoid all unnecessary carving or shaping in the legs; plain turning is amply sufficient, and much less costly. Nothing, to my mind, shows off flowers and silver better than an ebonised top left open in the centre, with good linen slips on the sides for dinner, easily removable, before the wine comes round after.

Instead of the ordinary sideboard, with its grotesque Sphinx-like legs and carved pedestals, and utterly useless mass of looking-glass back, with hideous carved scroll frame and top, I would suggest a plain but solidly handsome buffet, arranged for the reception of plate and glass, or for good pieces of china, the lower portion fitted up with a cellaret and liqueur tray, within a panelled cupboard front on one side, and a useful cupboard on the other, a few drawers for plate and other necessaries of a dinner table; between the cluster of shelves above, a small splayed mirror might be fixed, or arranged to reflect the many objects set on the buffet, and to help to brighten the room. Perhaps for convenience of serving, the central portion might be made into a sliding hatch, communicating with the small back parlour or breakfast-room, or a light lift from the basement might easily be made to run up in the lower portion; on either side might be *repoussé* copper or brass sconces for candles, arranged so as to light not only the buffet, but the end or side of the room at which it stands. Whatever portion of the work is made solid, should be brought right down to the floor with a slight plinth, so as not to allow space for the accumulation of dirt and dust, which cannot be cleaned without moving the furniture. The panels of the doors, when sufficiently high to be seen, might be filled in with low carving in relief, in box and other hard wood, as a contrast to the other work, or with marquetry or Japanese lacpanels; but

the use of miniature carving, fretwork, or turned ballusters a few inches in height should be avoided as bad in taste, and form, and expensive; all supports for shelving above should be as light as possible, so as not to hide the objects with which they are filled, and the backs may be formed of plain deal, covered with stamped leather or some other light stuff; the general furniture should be, as a rule *en suite*, essentially useful and comfortable, and free from anachronisms which are offensive and objectionable.

I see no reason why pitch-pine or deal should not be much more largely used in dining-rooms for buffets and panelling. This can either be simply painted in plain lacquer colour, or can be worked out with the greatest elaboration of colour and ornamental design and figure decoration on quite plain surfaces. I am quite sure that our rooms would be much more cheerful, if the money expended on cuttings, turnings, and costly carvings, were to be devoted to good artistic panel decoration on flat surfaces; like some of the old painted furniture of the fourteenth and fifteenth centuries. Carving is apt to get filled up with dirt, and requires constant care and time in cleaning.

In olden days, the most distinguished artists were not ashamed to devote their talents to panel painting, and my friend Mr. Marks, R.A., and other eminent artists of our own day, have shown us how furniture can be artistically decorated. Why should not we have furniture painted with hunting or sporting scenes, or stories of home life of town and country, and thus bring into the dinginess of London rooms some elements of good artistic painting, even as the Italians were accustomed to decorate their buffets, elbow chairs, and couches, with beautifully depicted stories, telling of the riches and magnificence of the citizens who possessed them, and of the ability of the painters who adorned them. One good painted panel is worth ten thousand times more than all the meretricious carving with which so much of our modern furniture is filled. The furniture so decorated not only does its duty, but speaks and tells a story. Good deal wall panelling painted red, or some other warm colour, if free from elaborate mouldings and carving, is almost as inexpensive as some of the gorgeous pattern flock papers painted in several tints, with which it is considered necessary to make dull and heavy the walls of many a London room. Above all, let the room be light and cheerful, the furniture strong, comfortable, and serviceable, and avoid everything which takes away, so to speak, from the freedom of the room. For lighting, I would suggest a central hanging-lamp, with good shade of subdued or warm tinted glass, throwing a pleasant soft light upon the table, without the heat and glare of the filthy compound which gas companies of the present day are content to give to us long-suffering inhabitants. Nothing tends to make an otherwise pleasant dinner so miserable and enervating as the heat and stuffiness engendered, in a brief space of time, by this nineteenth century abomination.

As regards the floor, the practice of covering the whole with carpets, good, bad, or indifferent, answers no purpose but to increase the upholsterer's bill, and to keep up a dust trap, which is not got rid of until the times of the annual spring or autumn cleaning. Paint them two or three feet all round in some good-wearing dark colour, by which two-thirds of the cost of the often useless, elaborate, and expensive carpet bordering is saved, and put the money thus saved into some good Indian or Persian carpet for the centre space, which, while warm and comfortable to the feet, is grateful and pleasant, with its harmonious colouring, to the eye.

The design and colouring of most carpets have been materially improved in the last few years, but we have not quite got rid of the atrocious floral and other sprawling patterns of our fathers' time. In Kidderminster, Brussels, and Wilton carpets, there are now innumerable simple designs, with no distinct or staring patterns, quiet in colouring, and moderately inexpensive; and a square carpet may be made with any of these, with a simple border to cover the central portion of the room. As a general rule, carpets should be darker in tone than the general wall decoration, so as to form a good back-ground for the furniture placed upon them. Turkey carpets are not always satisfactory, because the pattern, as a rule, is destroyed or broken up by the table, instead of being entirely seen, when used for its original purpose of reclining. The carpets themselves are expensive from their elaboration of design, and it seems waste of money to buy such coverings for dining-room floors, where the best part of the pattern is practically hidden by the dining table.

As regards colours, bear in mind that pure red is a perfect contrast to pure green, pure yellow to purple, and blue to orange. Many of you understand harmonious grouping of colours, but few study the causes.

A plain brass pole, or piece of $1\frac{1}{4}$-in. gas piping, is ample for curtain rods. Nothing can be worse than the heavy lacquered brass or wood poles, and unmeaning fringe valances, which only serve to show dirt and dust, and are execrable in taste. The library of the house should also be as comfortable as possible, with broad easy chairs, low centre table for books and periodicals, a large pedestal desk, with circular revolving top, to shut up all papers and keep them free from dust. This kind of table I consider invaluable to any man who really uses his library as a work-room, whether it be for real literary work and study, or for the ordinary examination and arrangement of household accounts; for it is quite impossible in London, on an ordinary writing table, to keep papers clean or tidy, and this circular-headed desk shuts down at once papers as they lie, which then cannot be "tidyed" by the housemaid, who would seem to take a pleasure in putting away papers and notes in all kinds of out-of-the-way corners; the table should have plenty of drawers and pigeon-holes, these latter not, as many of them are, an inch too narrow or two inches too wide for ordinary letters, but all made for the objects for which they are intended. It may seem absurd to say, think carefully of the use to which the drawers are to be put, but how often are they practically useless, or wasteful of precious room, by being made shallower or deeper than is required. The room should be surrounded with bookcases, the lower portion made to take large books, and with some part of it covered in with cupboard fronts, with shelving inside to file away periodicals and papers; the shelf which this lower projection forms will do admirably for the arrange-

ment of ornaments, small busts, or other personal things, with which a man crowds the room he really lives in; of course, I am speaking to those who make a den or working room of their library, and not to those who fit a back room up with various tiers of shelving, on which are arranged a library of books which are seldom looked at, and where the room is only occasionally used, and then only for the purposes of a cloak-room on grand occasions. Above this lower nest of cupboards and shelving should be shelving arranged for various sizes of books, part carried up all round the room, so as to be within easy reach; the top of these will be found useful for china or busts, or other objects of art, while the centre portions may be carried up to the ceiling, to give greater accommodation; all these breaks will take away from the stiffness of the room, and if properly arranged, will all assist in making the library a room pleasant to work or play in. All these cases can be made of plain deal, stained and polished, and are infinitely cheaper than the elaborate moveable cases of wainscot or walnut, in which the aim of the designer seems often to be to make the framework as expensive as possible, whereas, in truth, the books within are really what should be thought of and cared for.

The floor should be painted all over so as to be easily cleaned and dusted, and everything that is likely permanently to hold dust should be avoided. On the floor, thus painted, a few cheap Indian or other rugs may be laid about in places where most necessary and useful.

Too much trouble cannot be taken to make the library a pleasant room to live in; it should have everything arranged and adapted for use and comfort, and not be stiff and dreary with any set arrangement. The panels of any cupboard doors may be filled in with Japanese lacquer work or painted decoration; and here and there, in the recesses, nests of shelves may be fitted with projecting brackets, designed as part of them —and not looking like bats stuck on to a barn door—for pieces of china, vases of flowers, or busts.

I must not omit to say that, in the lower portion of the bookcase, should be arranged drawers—not carried down to the floor, for these are inconvenient—for use for prints and valuable photographs and sketches.

The library should be eminently home-like, with the wall space fitted up as conveniently as possible; on the top of the bookcases or nests of shelves; spring-roller blinds might be easily arranged in the cornices to draw down at night or other times, and fasten with a clip to protect and preserve the books, &c., within them.

Time warns me that I must bring my lecture to a conclusion, or I might offer many other suggestions for the decoration and furniture of the rooms I have specially referred to. I trust those I have made will be found of some practical use, and that above all you will believe that my aim throughout has been to avoid all dogmatic and set rules of fashion or design, and to insist only that truth and beauty of form and colour, combined with fitness and common sense, are the main elements of all true artistic treatment, in decoration and furniture of modern houses.

MISCELLANEOUS.

ROYAL COLLEGE OF MUSIC.

The following is the copy of the petition of his Royal Highness the Prince of Wales, praying for the grant of a Charter of Incorporation to the Royal College of Music, and a Draft of the Charter prayed for, which has been issued as a Parliamentary paper:—

To the Queen's Most Excellent Majesty in Council.

The humble Petition of your Majesty's dutiful and loving Son Albert Edward Prince of Wales, &c.

Humbly showeth,

That in the year 1875, a school for music, called the National Training School of Music, was established at Kensington Gore, under a committee of management, of which your Majesty's dutiful and loving Son Alfred Duke of Edinburgh, is chairman.

That such school has for its object the education of persons showing special aptitude for music, and unable to bear the whole of the expense of their education.

That the said school has, by the liberality of various donors, been endowed with considerable annual grants, to which your Majesty, your Petitioner, and other members of the Royal Family. the City Companies, the Society of Arts, and divers others of your Majesty's loving subjects have been contributors.

That the said Training School, having regard to the shortness of the time during which it has been established, has been very successful in educating as scholars persons of various grades, but is willing to have its sphere of action extended by being included in the proposed college hereinafter mentioned.

That in the judgment of your Petitioner, it is expedient that a Royal College of Music should be formed on a more permanent and extended basis than any existing institution, with the inclusion, as part thereof, of the National Training School at South Kensington.

That such a college would have a capacity to exercise a powerful influence on the cultivation, practice, and regulation of the science and art of music, and, further, might efficiently aid the promotion and supervision of musical instruction in elementary schools and elsewhere.

That in the judgment of your petitioner, it would be greatly for the benefit of the public, and for the advancement of music, if your Majesty would be graciously pleased to grant a Charter of Incorporation to your petitioner and other persons who may become members of the new college, under the title of "The Royal College of Music," or such other title as to your Majesty may seem fit.

Wherefore your petitioner humbly prays that your Majesty would be graciously pleased to grant such Charter of Incorporation as aforesaid, and your petitioner, as in duty bound, will ever pray.

(Signed) Albert Edward P.

PAPERS RELATING TO THE DRAFT CHARTER OF THE ROYAL COLLEGE OF MUSIC.

Victoria, by the grace of God, of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith, to all to whom these presents shall come, greeting:

Whereas by a Petition presented unto Us by Our most dearly beloved son, His Royal Highness Albert Edward Prince of Wales, Knight of the Most Noble Order of the Garter, it is amongst other things shown that it is expedient that a Royal College of Music should be formed on a more permanent and extended basis than any existing institution, with the inclusion as part thereof of the National Training School at South Kensington:

Now know ye that We, being desirous of promoting the advancement of the Art of Music, by the establishment of the said college, have, of Our especial grace, certain knowledge, and mere motion given and granted, and We do hereby give and grant, that our said most dearly beloved son, Albert Edward Prince of Wales, Our right trusty and well-beloved Councillor Hugh Lupus, Duke of Westminster, Knight of the Most Noble Order of the Garter, and Our trusty and well-beloved Sir Richard Wallace, Baronet of the United Kingdom, and Knight Commander of the Most Honourable Order of the Bath, and all other persons who are or may become members of the Corporation established by this Our Charter in pursuance of the provisions thereof, shall be a body corporate by the name of "The Royal College of Music," having a perpetual succession and a common seal, with a power to sue and be sued in their corporate name, and to acquire and hold for the purpose of the said Corporation without license in mortmain; and We do hereby declare as follows:—

1.—Purpose of Corporation.

The purpose for which the Corporation is founded is the advancement of the art of music, by means of a central representative body charged with the duty of providing musical instruction of the highest class, and having a capacity to exercise a powerful influence on the cultivation, practice, and regulation of the art and science of music, and further, having in view the promotion and supervision of musical instruction in elementary schools and elsewhere, as may be thought most conducive to the cultivation and dissemination of the art of music in the United Kingdom.

2.—As to the President.

The first president shall be his Royal Highness the Prince of Wales. On the resignation or death of the president, the vacancy shall be filled up by the nomination of a successor under the sign manual of the Sovereign for the time being.

3.—As to the Vice-Presidents.

The vice-presidents shall be appointed by the president, and their number after the first appointments shall not exceed 15.

Any vacancy in the office of vice-president may be filled up by the president for the time being, but it shall not be incumbent on the president to fill up any such vacancy so long as number of vice-presidents holding office be not less than four.

In the absence of the president, the senior vice-president present shall preside at general meetings of the Corporation, and at any meeting of any council or committee of the Corporation of which he may be a member.

The vice-presidents shall perform such other duties as may, with their assent, be imposed on them by the Council.

4.—As to the Principal and Vice-Principal.

The first principal shall be chosen by the president. Susequent principals shall be chosen by the Council.

The principal shall hold his office during the pleasure of the Council.

The vice-principal shall be nominated by the principal, subject to the approval of the Council, and shall hold his office during the pleasure of the Council.

The principal and vice-principal shall respectively be professional musicians.

5.—As to the Council.

The Council shall consist of three official members, that is to say, the president, the principal and vice-principal, for the time being, of the Corporation, and subject as in this our charter mentioned of 30 ordinary members.

The first ordinary members of the Council shall be nominated by the president.

One-third of the ordinary members of the Council shall retire from office in every year, but any member so retiring shall be re-eligible.

The offices of retiring members of the Council shall be filled up by the members of the Corporation in general meeting assembled, by the election of such persons, whether members of the Corporation or not, as they may think expedient. The ordinary members of the Council to retire during the first and second years succeeding the date of this our Charter shall, unless they agree among themselves, be determined by ballot.

In every subsequent year the one-third who have been longest in office shall retire.

A member of the Council elected in general meeting to fill the place of a retiring member shall hold his office for three years.

If at any general meeting at which an election of members of the Council ought to take place, the places of the retiring members are not filled up, the retiring members, or such of them (to be determined by agreement or by lot) as have not had their places filled up, shall continue in office until the general meeting of the next year, and so on from time to time until their places are filled up.

Any casual vacancy occurring in the ordinary members of the Council may be filled up by the Council, but any person chosen to fill such vacancy shall retain his office so long only as the vacating member would have retained the same had no vacancy occurred.

An ordinary member of the Council shall vacate his office as a member if he absent himself from meetings of the Council for not less than four months, unless the Council resolve that it is expedient that such member should not vacate his office.

Any member of the Council may resign by notifying his intention so to do in writing to the Chairman of the Council for the time being.

A person engaged in teaching in the College shall not be qualified to be elected or sit as an ordinary member of the Council, and any person who being an ordinary member of the Council becomes engaged in teaching in the College, shall vacate his seat on the Council.

The Council, with the assent of the President, may from time to time agree with any department of the Government, the Commissioners for the Exhibition of 1851, or any donors, to secure to such department, Commissioners, or donors, such representatives on the Council as may be thought expedient, and the Council may, with the view of carrying into effect any such agreement, by regulation capable of being altered from time to time by them, vary the provisions of this our charter relating to the Council, and substitute other clauses providing for the choice of such representatives, their tenure of office, and other matters as may be thought expedient: Provided that the three official members of the Council shall not be altered, and that the whole number of the Council shall not in any case exceed 36 members, exclusive of the official members, and that not less than two-thirds of the members of the Council, exclusive of the three official members, shall retire from office, and their places to be filled up in manner provided by this Our Charter.

6.—As to the Staff of Teachers.

The staff of teachers shall consist of masters and assistant-masters. The masters and assistant-masters shall be appointed by the principal, subject to the approval of the Council, and shall hold office during the pleasure of the Council.

7.—As to the Board of Studies.

The Board of Studies shall consist of the principal and vice-principal, and six masters.

The masters composing the Board of Studies shall be chosen by the principal, subject to the approval of the Council.

Of the six masters on the Board of Studies two shall retire at the expiration of every second year. The masters to retire at the expiration of the second and fourth years succeeding the date of this Our Charter shall, unless they agree among themselves, be determined by ballot. At the expiration of every subsequent period of two years the masters who have been longest in office shall retire.

The office of retiring masters shall be filled up by the Principal, subject to the approval of the Council, and any persons chosen to fill such vacancies shall hold their offices for six years.

A casual vacancy occuring in the office of master on the Board of Studies shall be filled up by the Principal, subject to the approval of the Council, and any person chosen to fill such vacancy shall retain his office so long only as the vacating master would have retained the same had no vacancy occurred.

A master on ceasing to hold office as a member of the Board of Studies, shall not be re-eligible as a member of the Board of Studies until the expiration of two years at least from the date of his retirement, unless the Council resolve, on the application of the Principal, that it is expedient that such master should be re-eligible, in which case he may be chosen by the Principal to fill a vacancy in the same manner as if he had not been previously serving as a member of the Board of Studies.

Any member of the Board of Studies may resign on giving notice in writing to the Principal of his intention so to do.

8.—As to the Pupils.

The pupils shall be divided into three classes—(1) scholars, (2) Government pupils, (3) students. The scholars shall be pupils whose education and maintenance, or one of them, is wholly or partially defrayed gratuitously. The Government pupils shall be pupils whose education is conducted in manner and on the terms agreed upon between the College and the Government. The students shall be pupils who pay for the whole of their education.

As to the Graduates.

Pupils who have passed the prescribed course of instruction and the prescribed examinations, shall be entitled to a certificate to that effect, and to the privilege of calling themselves graduates.

As to the Fellows.

The Fellows shall be divided into two classes—(1) ordinary fellows, (2) honorary fellows. The ordinary fellows shall be such associates or such graduates as have, by passing the prescribed examination, or otherwise complying with the prescribed rules, shown such distinctive excellence in music as to be entitled to the dignity of fellow. The Corporation will accept endowments for fellowships, to be held by such ordinary fellows as may acquire the same in the prescribed manner by competition. The honorary fellows shall be such persons, being foreigners or otherwise, as shall be selected by the Council as worthy of the distinction of an honorary fellowship.

As to the Associates.

The Associates shall be such persons as shall be selected by the Council as worthy of that distinction.

12.—As to the Donor.

Annual subscribers of £10 or upwards during the period of their subscriptions, and contributors at one time of £50 or upwards, or its equivalent, shall be deemed to be donors within the meaning of this Charter.

13.—Conduct of Business.

The instruction of the pupils shall be conducted under the direction and superintendance of the Board of Studies, subject to the regulations made by the Council.

Subject as aforesaid, the power of acquiring landed or other property, the erection or maintenance of buildings, the disposal by sale, exchange, or otherwise, of any lands, buildings, or other property of which they may become possessed, and all other powers of and incidental to the establishment and maintenance of the college, and the carrying into effect the purposes for the corporation is founded, shall be vested in the Council.

The Council may enter into any engagements with the Government respecting musical instruction in elementary or other Government school, including the inspection of schools, the conduct of examinations, the providing wholly or partially for the supply or education of musical teachers, the appropriation of scholarships or otherwise to persons educated in such schools, and any other matter in relation to the promotion of music in connection with Government aid which may be thought expedient.

The Council may negotiate with any musical bodies as to the conditions on which they will be willing to join with the Corporation. They may pay any sums incidental or consequential on such negotiations. They may make terms with any donors as to the appropriation of their donations for a building fund, or the endowment of fellowships, or scholarships, or otherwise as the Council may think expedient. They may affiliate any musical schools or societies with the Corporation, or affiliate the Corporation with any existing university. The Council may pay all expenses incurred in obtaining this Our Charter, and may do all acts and things, whether similar in character or not to those abovementioned, and may dispose of any funds in their power in such manner as in their discretion may be thought expedient for promoting the purpose for which the Corporation is founded. The Council are also empowered to create a home and to provide therein, wholly or partially, maintenance for scholars or Government pupils.

The Council may, with the sanction of the president, empower members of the Corporation, or any special class or classes of such members, to annex distinctive letters to their names, indicative of their membership or class of membership in the Corporation.

14.—Members.

The following persons shall be members of the Corporation, that is to say,—(1) the president for the time being; (2) the vice-presidents for the time being; (3) the Members of the Council for the time being; (4) the masters and assistant-masters for the time being; (5) the graduates; (6) the Fellows for the time being; (7) the Associates for the time being; (8) the donors:

Any body of persons, corporate or uncorporate, contributing such money as would entitle such body of persons if they were an individual to become a donor of the Corporation, may from time to time nominate any person belonging to their body to be a donor of the Corporation, and to represent them in the Corporation.

The honorary fellows shall not be entitled to vote at the general meetings of the Corporation, but every other member of the Corporation shall be entitled to one vote at a general meeting.

15.—General Meetings.

A general meeting of the Corporation shall be held once in the least in every year, at such time as may be fixed by the Council.

The Council shall present to the general meeting an account of the condition of the Corporation, with such particulars as they may think requisite.

The general meeting shall proceed to fill up by election vacancies in the Council, and to such other business as may be laid before them by the Council.

Ten members, personally present, shall be a quorum at any general meeting of the Corporation.

Subject to such provisions of this our charter as define the purposes of the Corporation, the Corporation may in general meeting, from time to time, by passing a special resolution in manner hereinafter mentioned, alter any of the provisions of this our charter, and make new provisions in place thereof or in addition thereto, and any provisions so made by special resolution shall be deemed to be provisions of this our charter, of the same validity as if they had been originally contained therein, and shall be subject in like manner, from time to time, to be altered or modified by any subsequent special resolution: provided always that such alterations and provisions shall not be of any force unless the same have been recommended by the Council, nor until they have been sanctioned by the President, and have been approved by Us.

A resolution of the Corporation shall be deemed to be special which has been passed at the general meeting of the Corporation, and confirmed at a subsequent general meeting held at an interval of not less than 30 days nor greater than two months from the date of the meeting at which such resolution was passed, subject to the conditions following:—

(1.) When a poll is demanded, the majority at the first meeting must consist of not less than three-fourths of the votes recorded, but a bare majority of the votes recorded will suffice for confirming the resolution.

(2.) Notice of both meetings and of the object for holding the same, must be given according to the mode in which notices of general meetings are required to be given by the regulations of the Corporation for the time being in force.

16.—Meetings of the Council.

The Council shall meet for the dispatch of business, and shall from time to time make such regulations with respect to the summoning, notice, place, management, and adjournment of such meetings, and generally with respect to the transaction and management of business, as they think fit, subject to the following conditions:—

(1.) The first meeting shall be held on such day after the date of this our Charter as may be determined by the President;

(2.) Not less than two meetings shall be held in each term;

(2.) The quorum shall consist of not less than five members.

The Council may delegate any of their powers to a committee consisting of such number of members of their body as they think fit; but any committee so formed shall, in the exercise of such powers delegated, conform to any regulations that may be imposed on them by the Council.

The Council may appoint an officer to be styled the Registrar, and may assign to him such duties as secretary, or otherwise, as they think expedient.

17.—General Regulations.

The Corporation will provide for the instruction of their pupils, whether scholars, Government pupils, or students.

The Council may make, and when made may add to, alter, or rescind regulations in relation to—

(1.) Any matter by this our Charter directed to be prescribed;

(2.) The conditions on which scholarships, fellowships, contributions to building funds, and other endowments of the Corporation, are to be accepted.

(3.) The privileges of members of the Corporation exclusive of the right of voting;

(4.) The course of instruction to be pursued in the Corporation;

(5.) The conduct of the proceedings of meetings of the Corporation and of the Council, and of the Board of Studies;

(6.) The mode of electing new members of the Council; and

(7.) In relation to the appointment of officers and servants, and in relation to any matter or thing, whether similar or not to those above-mentioned, required for the purpose of supplementing the provisions of this our Charter, or for carrying into effect the purposes of this our Charter.

18.—Definitions and Saving Clauses.

In the construction of this our Charter, the following words and expressions, unless there is something in the context inconsistent with such interpretation, shall have the meanings hereafter attached to them, that is to say—

"The Corporation" means the Royal College of Music, established by this our Charter.

"Persons" include a body of persons corporate or unincorporate.

"Senior," as applied to any person in office, means the person who has been longest in such office; but where several persons have been appointed to the same office on the same day, means, as between such persons, the person first named in the instrument of appointment.

"Professional musician" means a person who is at the time present making his living by the profession of music.

"The profession of music" means playing on any musical instrument, singing, composing music, or teaching any of such arts.

If any question arises as to whether a person is or is not a professional musician, such question shall be decided by the Council, and the decision of the Council shall be final.

Words in the masculine gender include the feminine, and words in the singular number include the plural, and words in the plural number include the singular.

The Council shall make provision for constituting the existing scholarships of the National Training School of Music scholarships of the Corporation, as may be agreed upon.

The consent of the persons who have given scholarships to the Training School, shall, whenever necessary, be obtained to any arrangement made in pursuance of this our Charter in respect of such scholarships.

The Council shall make provision whereby persons, who are being educated in the National Training School of Music, shall have allowances made to them in respect of their instruction in the Royal College of Music.

MR. JAMES NASMYTH, C.E., ON FREEHAND DRAWING.

The eminent inventor of the steam-hammer writes to the *Times*, to testify to the importance of freehand drawing. Mr. Nasmyth says:—

"All those who take an interest in truly useful and practical education must feel obliged and thankful to Sir Henry Cole for his excellent letter in the *Times* of September 22nd. Sixty years' experience with engineering works, and with the mechanics and other classes of workmen engaged in such occupations, enables me to say that of all the useful acquirements beyond those of 'the three R's' is that of drawing. By the term 'drawing' I mean the art of representing the forms of natural or artificial objects by lines, which, when even rapidly sketched by a practised hand and educated eye, can bring an object before you with a distinctness and rapidity such as no oral or written

description could accomplish. During a long and active life, engaged in occupations in which I have had daily occasion to communicate definite ideas to others in respect to forms and combination of forms, the possession to a certain extent of the power of rapidly sketching such, in order to convey correct ideas of what I desired to communicate to others, has done me more real service than any other acquirement or faculty I may be in possession of. If we desire to produce really useful and effective men by means of our schools, let the pupils, by every opportunity, acquire this valuable art of hand-sketching. That is the kind of drawing which of all others will best serve the general affairs of life; and, without any attempt at producing artists as such, if our schools would confine their efforts in this direction to the simple exercise of the hand and eye, and thus enable the pupils, with pencil or chalk, to represent the object they desire to bring before you, the possession of this power will be found to transcend in its general usefulness all 'tongue acquirements,' and do more to lead to success and enjoyment than any other attainment I know of. Nothing but a most earnest feeling of the practical importance of this subject would have caused me to venture to place it before your attention."

The letter of Sir Henry Cole, which called forth this opinion, was as follows :—

"The Postmaster-General is reported in the *Times* of September 21 to have said, at a meeting to distribute the prizes gained in the Oxford and Cambridge Examinations in Salisbury, that 'he should no more think of advocating that every one should study mathematics than he should of advocating that every one should be taught music or drawing.' Clearly Mr. Fawcett has no ear for music, and does not recognise its universal use in churches, chapels, in the army, in the theatre, in the homes of all classes, and as an instinctive recreation in all nations. Where education is most cultivated, music, as in Germany, ranks as an essential. Music has crept into our own Education Code in an imperfect way, costing more than £100,000 a year. Then, as to drawing, it is next in use to writing, and even of more importance than writing in handicrafts. Mathematics rank next to arithmetic; but music and drawing, I protest, come into the very elements of education."

NATIONAL TRAINING SCHOOL FOR COOKERY.

The following is extracted from the *Times*:—Her Majesty's Commissioners for the Exhibition of 1851, having granted a site on the east of the Royal Horticultural Gardens for the erection of the new building for Technical Education by the City Guilds, it has become necessary for the National Training School for Cookery to make alterations in its premises, which formerly extended on to the site now appropriated to the City Guilds. These alterations, carried out under the supervision of Sir Daniel Cooper, a member of the Training School Committee, have considerably improved the arrangements of the various kitchens. The two chief—viz., the artisans' cookery kitchen and the ordinary practising kitchen—are now merged into one great hall, and divided one from the other by a large double-facing range. Adjoining this hall are on the one side new waiting-rooms for students, and on the other store-rooms, larder, &c. Further on is the lecture and demonstration hall, and beyond this is a kitchen, in which instruction is given to classes of children sent by Board schools and by the City Guild of Cooks. At present but few children are sent by the London School Board; but under the new arrangements it is hoped that greater use will be made of the accommodation provided for elementary school-children. The winter session of the Training School commenced on Monday, 20th September.

The importance which attaches to cookery as a branch of instruction in domestic economy is becoming more widely felt by the Education Department. In the recently-published report of that Department, this fact is brought prominently forward in the body of the report, special mention being made of the 233 schools throughout the country, where due provision is made for the teaching of cookery. The effect of a departmental minute authorising training colleges to send teachers to the National Training School for Cookery has not as yet developed itself to any considerable extent. The increased conveniences afforded through the alterations of the premises at South Kensington may possibly conduce to greater use of the special courses for training teachers by the authorities of the different training colleges in and about London.

It is understood that the Committee of the National Training School for Cookery look forward to the time when they may have a thoroughly permanent building in the place of the temporary premises now occupied. Indeed, the Duke of Westminster, as President of the National Training School, has applied to her Majesty's Commissioners for the Exhibition of 1851 for a site; and an effort will probably soon be made to raise a sufficient sum, not only for creating an important institution to be devoted to instruction in food and its preparation, but also for establishing a home where students at the various training schools of art, of science, of cookery, of needlework, and of music—now located in South Kensington and Kensington-gore—may obtain board and lodging during their training. To carry out such a scheme, considerable funds would, no doubt, be required. The neighbourhood of the new City and Guilds of London Institute to the possible site of this projected establishment should furnish additional reason for the various guilds, especially those connected with food—such as the bakers, brewers, butchers, cooks, coopers, distillers, fishmongers, fruiterers, grocers, poulterers, salters, vintners, not to mention many others interested in technical and domestic education—to come forward and help in placing upon a permanent basis an institution worthy to be regarded as a National Training School for Food and its Preparation.

WOMAN AS A SANITARY REFORMER.

At the recent meeting of the Sanitary Institute, at Exeter, a lecture on this subject was delivered by Dr. B. W. Richardson, F.R.S.

After some introductory remarks, the lecturer said there was not any difficulty in the way of making woman the active domestic health reformer. The only thing which required to be considered was the method of bringing her universally into the work, and making the work a permanent custom or fashion, the neglect of which would be regarded as a moral defect. There was no nobler occupation than that which was applied under the head of domestic care and nourishment of health, and he would press the office of prevention of disease upon women, not simply because they could discharge its duties, not simply because it pertained to their special attributes, their watchfulness and their love, but because it was an office which man could never perform, and because the whole work of prevention waited and waited until woman took it up and made it her own. The man was abroad; disease threatened the home, and the woman was on the spot; the house was her citadel. But by what process of training, it might be asked, could women so govern domestic life that diseases might be prevented wholesale? His reply was that the training required was simple; that

every woman who willed to go through it might do so, and might become mistress by its means of the destinies of the world. A woman could master physiology so far as to understand the general construction of the human body. She could make herself acquainted with its nine great systems—the digestive, the circulating, the respiratory, the nervous, the sensory, the absorbent and glandular, the muscular, the osseous, and the membranous. She could be led to comprehend the leading facts bearing on the anatomy and function of those systems, to understand what part food played in the economy, the relationship which solid foods bore to liquid, and to learn what the particular foods were which were required for the young during the periods of active growth. If, possessing such knowledge, she would only utilise it as she certainly would, we should, he would venture to say, have in this country hardly one deformed child at the end of one or two generations, and rickets, with all its attendant miseries of bowed legs, crooked spines, and humped backs, would have passed away as if by the spell of an enchantress. After the understanding of the digestive system, a woman should learn the principal facts relating to the circulation of the blood. She should know completely the mechanical construction of the heart, and how the heart was sympathetically moved in its action; for in the early days of childhood the whole after life might be shaped by the tone which was given to that organ. The complete structure of the breathing lungs should also be as plain before her as the outward forms of those things she knew best. Equally clear to her should be the leading facts bearing on that receptive system of the body into which the external universe transported itself. How many young and middle-aged people, he would ask, were going about in spectacles, unable to see any object with the naked eye which was not uncomfortably near? How many of those also had their backs distorted; and whence arose that strange combination of deformity? The question was answered by Mr. Liebreich, who said:—The greater part of it is induced while acquiring the art of writing. When the body is still being formed and is unconsolidated, the child is permitted to sit with the chest and back bent forward, and with the eyes close to the paper. Thus the natural refraction of the lenses of the eyeball is permanently perverted; the parallel rays of light are brought to a focus before they reach the retina, and there is produced the deformity of short sight, for the correction of which an artificial lens or glass is required. At the same time the back abnormally bent retains its abnormality, and short sight and curved spine go together, twin defects of one error which ignorance of the simplest principles permits the devoted and affectionate parent to overlook, as if it were a necessary and therefore irrepressible and irremediable evil. Suppose the women of our country trained to a knowledge of the first and elementary truths about visual function and guided by them, was it not all but certain that another deformity would in a generation become virtually a thing of the past? To the knowledge of nervous function it would be desirable to add a few facts respecting the great glandular system of the body, and the woman should, in the last place, study with special care that extended membranous expanse which was so sensitive to external influences of heat and cold, and in that way learn the value of keeping the functions of the skin in due cleanliness, so that the bath would come to be regarded by her not merely as a luxury, but as one of the necessities of daily life. Having thus made herself acquainted with the living house, she would be tempted to inquire into the mysterious construction of that deadly-lively house which until lately the architect and builder had pitchforked into street and square, with a facile and contented wisdom of wigwam descent. She would endeavour to find out how she could most effectively and economically maintain in her house, in the varying seasons, an even and equable temperature. She would aim at discovering in what way she could keep the air of the house free from that most objectionable of mischief, dust. She whould demand to have marked for her on a map or plan the precise position of every drain-pipe in the establishment, and would insist with intelligent skill on having every drain kept as systematically clean as the china in the housemaid's cupboard. She would learn enough of the chemistry of water to enable her to determine, with as much facility as she could tell whether a looking-glass was clear enough to reflect back without fault the image of her face, whether the water was wholesome and drinkable, and she would possess a sufficient amount of skill to direct how an impure water might be purified and made safe for the purposes of all domestic requirements. She would see that sunlight found its way as freely as possible into every apartment, and that damp had no place in any one of her rooms. She would insist that where any living thing that ought not to be present in a house existed in it, that house was unclean. She would see to the biennial purification of her dwelling. She would make the very act of cleaning and cleansing clean, and the scullery, the landing, the bath-room, the laundry, would be the cynosures of her household. As to food, an intelligent study based on a knowledge of the natures and uses of foods, would enable her not merely to make the best selections and carry out the best modes of preparation now known, but would lead her to introduce new and improved methods of cooking. She would be able better than anyone to put to the test of experience the question whether it was good or necessary to have recourse for human food at all to the living animal creation. For his own part, it did not seem to him that man was constructed to be a carnivorous animal. It was by no means certain, seeing that the vegetable world was the original source of every particle of living food, that it was well to go for it to secondary sources of supply. But the point was one upon which he was in doubt. That doubt it was in the *rôle* of the educated woman to solve, and, however she might solve it, sure he was that in watching carefully over food and feeding she would quickly discover a world of facts that would be of unspeakable value. As to the art of the diagnosis of disease, he did not think the knowledge of it was necessary for women, except in a limited degree; but he would have them cultivate it to the extent of being able to tell the correct names and characters of the more common diseases, and of knowing by sight those which were contagious. To that knowledge they ought to add an acquaintance with the facts bearing upon the periods of incubation of those diseases, while all the best methods of preventing disease should be at their fingers' ends, and the rule of the sick room should be their constant care, for, as he had said many times, if, in the management and treatment of the acute and many of the chronic diseases, he could obtain in our climate absolute control of the fire and the windows of the sick room, he could determine the course of the illness. Finally, a woman ought to have such a training as would enable her to resist with her full persuasive might that process which he had elsewhere called the intermarriage of disease, for she would know that diseased heredity united in marriage meant the continuance of that heredity, as sure as two and two made four.

NOTES ON BOOKS.

Electric Light: its Production and Use. By J. W. Urquhart and F. C. Webb. London: Crosby Lockwood and Co. 1880.

This book is intended to give a simple and popularly

intelligible account of the various methods employed for producing the electric light. The ordinary voltaic batteries are described, and instructions are given as to the method of fitting, keeping them in order, &c. Various magneto and dynamo-electric machines are described, including the Gramme, Siemens, Wilde, Weston, Lontin, Brush, Wallace, Farmer, and others. Similarly, a number of lamps are described, including one by the inventor himself, which is recommended for rough work. In this, plates like those of the Wallace lamp are employed, but the principle on which the lamp works is different. The work is free from technicality, and is evidently intended for the use of persons who are not specialists, but wish to acquire a knowledge of the subject.

GENERAL NOTES.

Postal Indicator.—The contrivance for the purpose of indicating on pillar post-boxes the time of the next collection of letters, which has already been referred to in the *Journal* (vol. 27, p. 1,012), as in use in Manchester and Liverpool, is now being introduced into Edinburgh. The indicator is specially useful in those instances the boxes may happen not to have been cleared, although the stated period is already passed.

School of Art Wood-Carving.—Free studentships in both the day classes and the evening classes of the School of Art Wood-Carving, at the Royal Albert Hall, Kensington, are at present vacant. These studentships are maintained out of funds provided by the City and Guilds of London Institute for the Advancement of Technical Education. Forms of application and prospectuses of the school may be obtained by letter, addressed to the Secretary, School of Art Wood-Carving, Royal Albert Hall, Kensington, S.W.

New South Wales.—The following return shows the extent of the electric telegraph lines of this colony during the year 1879:—Extent of electric telegraph line wire in actual use on December 31, 12,426 miles 16 chains 3 links; number of electric telegraph stations on December 31, 273; number of telegraph messages transmitted during the year, 1,175,218; total revenue of electric telegraph department for the year, £80,490 0s. 6d.; total expenditure of electric telegraph department for the year, exclusive of interest on cost of construction of lines, £103,923 0s. 2d.

Raisins for Wine in France.—The *Journal of Applied Science* states that, in consequence of the dearth of grapes for wine-making in France, owing to the *phylloxera*, a large trade has sprung up in the import of dried raisins. In 1879, there were imported into France over 51,000,000 kilogrammes, and in the first six months of 1880, 48,000,000 kilos., so that in eighteen months 99,094,704 kilos. of raisins were received from foreign countries. One kilogramme of raisins is sufficient in general for making three litres of wine, so that the total production from this source may be estimated at 2,972,841 hectolitres. The sale of wine made from these raisins at the average of twenty francs the hectolitre, represents the sum of 2,972,841 francs.

Compressing Fluid Steel.—*Engineering* notices a proposal which has been lately made to effect the compression of fluid steel, by placing in the ingot mould on the top of the fluid metal a charge of nitrate of soda or other solid which evolves gas on being heated, the top of the ingot mould being then closed, and the pressure due to the gas generated being allowed to act on the fluid steel. This mode of operating was proposed—according to the same authority—by M. Antoine Galy-Cazalet, of Paris, some thirteen years ago. M. Galy-Cazalet proposed to use a mixture of 80 parts of nitrate of soda with 20 parts of charcoal, the mixture being introduced through a cock fitted to a cap affixed to the head of the ingot mould. With a space of 30 cubic inches capacity between the fluid metal and the ingot mould cap, the introduction of ¼ oz. of the mixture is stated to give a pressure equal to that of a head of metal 90 ft. high.

Patent Record.—The number of *Engineering* for October 1, contains the first instalment of an illustrated "Patent Record," compiled by Mr. W. Lloyd Wise. The chief feature of this record is the illustration of the abridgments of mechanical specifications, by means of small diagrams. The suggestion has frequently been made that the Patent-office itself should issue something of the sort, as is done in Canada and the United States, but it has never been acted upon. The classified abridgments issued by the office are not illustrated, and this naturally much diminishes their value in the case of mechanical inventions.

East Anglian Fisheries Exhibition.—An exhibition of fish, aquatic birds and plants, machinery and implements of every description employed in sea or inland fisheries and fish culture, will be opened at Norwich, under the auspices of the Norfolk and Suffolk Fish Acclimatisation Society, at Easter, 1881. The objects exhibited will be arranged under the following six classes:—1. Pisciculture; 2. Fishing; 3. Social Condition of Fishermen Afloat and Ashore; 4. History of Fishing; 5. General: including fish of all kinds, birds that prey upon fish, amphibious and marine animals, fish oils, fish manures, aquatic flora and fauna, corals, shells, &c.; 6. Collections within the scope of the preceding five classes. Applications from intending exhibitors should be made to the hon. sec., Mr. W. Oldham Chambers, London-road, Lowestoft.

Banking Examinations.—The Institute of Bankers have issued a programme of the examinations which must be passed by those who wish to obtain their certificates The subjects are:—1. Arithmetic and Elementary Algebra; 2. Book-keeping; 3. Commercial Law; 4. Political Economy; 5. Practical Banking. The examinations are divided into two parts, extending over a period of two years, the first examination being of a preliminary character; and the second to be held after the lapse of not less than one year from the first, being of a more advanced character. Both examinations are held in the month of May of each year, and candidates must give notice to the Secretary of their intention to present themselves for examination before the 1st of April. Candidates are informed that bad handwriting may be visited with loss of marks, and that the general style and intelligence of the answers will always be taken into account.

Chrome Ores of California.—Among the varied mineral riches of California, that of chrome ore, for the manufacture of bichromate of potash, so largely used in making colours and pigments, and in charging batteries for telegraph purposes, is assuming a remarkable importance. The chrome ore is found associated with serpentine, and the mines are situate near San Luis Obispo, from the shipping harbour, of which—Port Harford—15,000 tons have been sent away within the last three years. The average production yielded from 2,000 lb. of chrome iron, containing 50 per cent. of chromium, is about 1,600 lb. of bichromate of potash. During the year 1879, the following were the statistics of the trade:—Import of bichromate, 2,624,000 lb.; domestic manufacture, 4,258,009 lb.; total, 6,882,000 lb.; and, as the requirements of chemical science are annually increasing, it is likely that a considerable mining industry will be added to those already existing in California.

Native Oxide of Antimony.—Among the papers read before the meeting of the American Association of Science, was a communication by Mr. E. T. Cox, on the oxide of antimony deposits in Sonora, Mexico, about 30 miles from the Gulf of California. The district is mountainous, the hills being in short narrow ranges, with table-land lying between, composed for the most part of broken and highly porous material. The formation consists mostly of granite and subcarboniferous limestone, with porphyry, quartzite, and trachite dykes. Extensive fissures exist in the rocks, and in these the metal occurs from 4 ft. to 20 ft. wide, and, so far as is known at present, to a depth of 30 ft.; the oxide of antimony being almost pure and very uniform. The area over which these remarkable deposits occur is limited, being about five miles long and half a mile wide. They are being worked by a Boston company, who possess extensive claims, on some of which antimony ore stands up in ridges above the surface, and can be traced for some hundreds of feet. The oxide contains on an average about 50 per cent. of pure metal, much of it reaching 77 per cent. The principal impurity is silica. It is believed that at lower depths that have yet been reached the nature of the deposits will be found to change gradually to sulphide of antimony.

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council are Trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "Students of the Schools of Art who in annual competition produce the best Designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones;" the prizes to "consist of a bound copy of Owen Jones's 'Principles of Design,' a Bronze Medal, and such sums of money as the fund admits of."

The prizes will be awarded on the results of the Annual Competition of the Science and Art Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

The next award will be made in 1881, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

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Lecture V.—Delivered Monday, May 4.

The Drawing-room and Boudoir, Bedrooms, and Offices.

The drawing-rooms of a London house should be the rooms, of all others, in which good taste, both in decoration and furniture, should be everywhere apparent; the rooms wherein we practically live, talk, play, and receive our guests, are essentially the ladies' rooms of the house, and should be decorated in a pleasant, cheerful manner, without stiffness or formality. The walls should be pleasant things to look upon, not cold and dreary blanks of mere one-tinted paper, varied perhaps with birds, or bunches of flowers in gold, scattered here and there in monotonous array. The furniture should essentially be comfortable, couches and chairs pleasant to lounge and really rest on, not so-called artistic monstrosities, on which it is impossible to do one or the other. The rooms should, above all, look and be home-like in all their arrangements, with ornaments, books, and flowers, not merely arranged for show, but for pleasant study or recreation. Here, especially, the usual good taste of the ladies of the house may find, if they will, innumerable ways of rendering their especial quarter of the house bright and cheerful, and one in which the home circle, as well as guests, may feel at once at ease and at rest. Any scheme of decoration, therefore, which shall consist merely of so-called artistic papers, arranged in two or more heights, in the present indiscriminate fashion, without reference to the proportion of the rooms, high or low, long or square, or of stiff spider-legged furniture, of would-be quaintness in make or shape, covered with cretonne or stuff, more or less to match the paper—anything, indeed, that shall give a cold, comfortless, not-to-be-touched appearance, a sort of culminating finish of so-called high art decoration—is as much a mistake as the dreary lifeless formality of the gilt and gingerbread type of imitation French work, so long affected.

The art-work in the room should assist, not take away from, its home-like feeling. We want a room we can live in, delight in, and be really at home in; not a museum in which we may walk about and admire, but must not touch, in which everything seems got up in the highest art fashion, which you are to look at and say, "How pretty! how lovely!" but which, somehow or other, will probably lead many common-sense people to go away dissatisfied, and think that if this kind of frozen art is the real artistic bread we are to partake of, there is but little real satisfaction in it. Surely all this kind of stilted decoration is giving a stone when people are asking for bread!

A drawing-room should not only contain works of art, and books for pleasant study, but should also be a room in which you need not fear to move or joke, or have that always pleasant hour before dinner with the younger members of the house. If the room be bright and cheerful with art work of all kinds about, these little ones will be imperceptibly undergoing a pleasant mental training, while they will not be made to feel that art is a thing of which they are to be afraid, or by which their pleasant young feelings and joy of life are to be frozen and subdued. Do not make children believe that they must not move or play in a room, because they will disturb or damage the art-furniture, ornaments, or set arrangement; or they will learn to detest so-called high art as intensely as I fear many of them do going to church, from the injudiciousness of some parents forcing upon them, in early life, an overdose of it.

The one unfortunate thing, to my mind, now-a-days, is the everlasting seeking after some novelty in papers, curtains, or other hangings. Everybody wants to have a room different from their neighbour. Decoration is being done as a fashion, not from any real love of it. Of course, we should not like to see room after room repeating itself in

decoration, but I see no reason why a few really good papers should not be the groundwork of real artistic decoration, when the narrowness of worldly circumstances prevents the more elaborate and more expensive artistic hand decoration, in paint or distemper, and let the rest follow from the design of the artist; then we might hope for real art-work, instead of the cold formality and everlasting interchange of two or three colours. As a critical writer on art decoration has said, "If the papers on our walls, and the curtains we hang in our rooms, were, even at second-hand, but the record of the fresh impressions and the graceful fancies of artists of our own day, instead of being encumbered with mechanical pattern work, struggling to be artistic, it would better than all the present miserable striving after novelty." Mr. William Morris, artist and poet, has to my mind, realised this in many of his designs for wall papers and hangings. Not to have what your neighbour possesses, is the bane of decorative art; if we could give someone the monoply of some half dozen or a dozen really good papers, plain and good chairs and tables, we should be at peace; "the refinement and luxury would make frugality once more possible."

Without in any way seeking to object to or despise real individuality or originality in art decoration, I must protest against the craving after eccentricity, and so-called novelty, which is called "originality," and the striving after quaintness, bad in taste and effect, which is called "individuality." The individuality of the true artist will show itself in many ways in the decoration of the house, in the tone and treatment of the colouring and furniture of the various rooms, in all of which there will be grace and beauty, and harmony of general effect and contrast; so that, although there be perhaps a distinct difference from other houses, marking the artistic individuality of the owner, there will be no stagey and striking effects, no glaring colours, or fantastic forms to tire and offend the eye. I venture to think that any room or house decorated after some set form, so that it be stamped as the work of this or that fashionable decorator, is utterly a mistake—an example of that fashion which throughout I have sought to deprecate, and of a set style which is based on fashion only, and which in a few short years will have to give place to some other style.

The aim of all true artists should be, so to design and decorate the buildings of to-day that they may be looked upon as equally beautiful, equally artistic, and equally appropriate a hundred years hence; and that, as we to-day look with pleasure and admiration on the work done two thousand years ago in Pompeii, so may we have decoration, in our day and generation, which in future times shall be looked upon with equal pleasure and delight. I can conceive nothing more opposed to all true decorative taste than to have one room Pompeiian, a second mediæval, and a third Queen Anne; while, to complete the anachronisms of the house, a fourth shall be gilt and carved to imitate a Chinese joss house, or an Indian temple. If the general effect be not vulgar and trashy, it will be suggestive of no real thought or feeling, but rather of that poverty of invention and artistic design which finds shelter under the adaptation bodily of other men's work.

The true artist should have an ideal of his own, of simple refinement and graceful completeness, which will save him from the temptation of extravagance. As a rule, it is the mere decorator who makes art decoration costly and extravagant; he or she cannot see that simplicity of colour and treatment are better than all the heavy work of set patterns, all the colours of the rainbow, or all the gold they can use. In the drawing-room a dado is not, as a rule, desirable, but this will of course depend on the character and design of the furniture and proportion of the room. Cabinets, bookcases, and general furniture of unequal size and height, are better framed against the general colour of the walls, than cut in two by a dividing dado, or chair rail. I would retain a broad frieze under the cornice, at the top of the room, and decorate it, if possible, with good figure decoration, either in oil or distemper. Anyway, try to have some pleasant lines of colour in the upper frieze, with distemper and stencil ornament of good form; or if you have nothing better, get some of the exquisite Japanese drawings of birds and flowers, and frame them in panels; but, above all, avoid stiff conventional decoration, which, however well done, is always lifeless and unsatisfactory, and tires and palls upon the eye in a very short time. Under this frieze may be a broad gilt or painted moulding, with picture rods of light painted or gilt iron, as I have before suggested. Below, the walls should be covered with some good decorative paper, a paper which will look bright and cheerful, with or without pictures; such a one is Messrs. Morris's "pomegranate" pattern; but there are very many others of almost equally good design, and there need be no difficulty, therefore, in selecting such a covering at no greater cost than the French papers with which it has been thought necessary to cover our walls so long. Avoid stiff and staring patterns, and all patterns where lilies, primroses, and other flowers are frozen into conventional forms, and have an unnatural and lifeless look. As regards the colour of the woodwork in a drawing-room, this must depend much upon the paper, or general tone of wall colouring selected. Such a paper as that I have named, having in itself such a power of colour, looks well framed in with black; if black is used, it should be finished in what is technically called half or bastard flat; for, as a rule, any varnish or glaze would make the black too pronounced; if gold is used, it should be in masses, and not in thin lines; the panels, therefore, should be entirely gilt, and can hereafter be decorated with flowers, painted slightly in their natural colours.

For a drawing-room in a large house, where, to a certain extent, it is required only for great entertainments—the ladies' sitting-room and general friendly reception-room being provided for in some smaller room in the house—a rich and effective treatment of the wall would be with a low panelled dado of dark black, with a delicate interlaying of ivory-toned stencil ornament, the doors and general woodwork being painted to match, the general wall surface coloured bright warm-coloured yellow, and powdered all over with a flower pattern or diaper, of a darker tone of golden brown, the frieze being coloured a delicate vellum colour or ivory tone, with arabesque or figure decoration

in black, the cornice treated with delicate shades of brown and green, and the ceiling slightly tinted to match the frieze.

I saw lately a drawing-room of a newly-built Queen Anne house, in which the whole of the lower portion of the walls was covered with a good yellow-pattern paper, the woodwork painted a cream-coloured white and varnished, and the frieze formed in decorative plaster-work in very slight relief, like Adam's work; the ceiling formed after similar designs, and all slightly tinted like Wedgwood ware. The general appearance was bright and cheerful, and the low tone of colour throughout formed an excellent contrast to the Persian rugs, marquetry furniture, blue and white china, and other decorative objects in the room; there was a bright home-like look, pleasant to see, and yet it was eminently an artistic room, in which money had in no way been lavishly or carelessly expended.

I give a few other examples of the general treatment of the colouring and decoration of some few drawing-rooms, which suggest themselves as generally good in treatment:—

1. Drawing-room, about 28 ft. by 18 ft., and 14 ft. high.—Adam's ceiling, in low relief, tinted in "Wedgwood" colouring; the cornice relieved in somewhat stronger tones; the walls hung with "brocade" paper of pale Indian blue, divided by pilasters of "Adam's" arabesque, painted in quiet tones of brown, warm greens, and russets, with carved medallions in each. Dado and woodwork of quiet cream tint, with line ornaments in drab and gold.

2. Drawing-room, 30 ft. by 18 ft., and 13 ft. 6 in. high.—The plain ceiling divided into three, and ornamented with low relief Adam's ornament, very lightly tinted, and slightly relieved by gilding cornice, picked out to harmonise with the walls. The walls hung with crimson ground "brocade" paper, with a pattern in very dull white and gold; the dado and woodwork black and gold, with margins of rich maroon, next the gilt mouldings of the panels.

3. A boudoir, 16 ft. square, and nearly as high. —Plain ceiling, decorated in arabesque of quiet colours. Walls divided by an architrave moulding, so as to reduce their extreme height; the upper 3 ft. 6 in. painted with ornament on light ground; the lower portion hung with silk damask of quiet tone of pale blue; dado and woodwork light, with gold lines and fine stencil decoration; curtains light, with a little blue introduced.

4. Small drawing-room or boudoir, 12 ft. high. —Flat ceiling, panelled out, with a painting about 8 ft. by 4 in. in centre, with low relief ornament surrounding it. The whole room panelled 9 ft. high, with pale wainscot oak; the space above this hung with embossed leather paper, with pattern in gold, and colours of a light dull green tone. Curtains, silk and wool tapestry. Floor, oak, rather darker than walls, with Oriental carpets. Furniture, dark mahogany; the coverings varied to some extent. A few water-colours hung on the oak panelling; chimney-piece carried up in light oak, with arrangement for bronzes, statuettes in side niches, and spaces for china.

5. Boudoir.—Ceiling divided with set panels, by ribs of cedar colour. Centre octagon, with radiating foliage on gold ground; eight circular panels containing paintings of children, alternately two and one, representing the months; the other panels delicately bordered with stencilling. Cornice cedar colour and gold: walls hung with a silk material of small pattern; mixed gold and greenish blue. Dado of cedar about 4 ft. 6 in. high, with narrow shelf for small china, &c. Stonework of window and recesses decorated with bramble foliage in russet green on the stone ground. Floor, oak parquet, with Indian carpet. Chimney-piece carried up and coved into ceiling, of dark walnut and gold, with some embroidery on velvet panels. Cabinets to match.

In the treatment of the drawing-rooms much must naturally depend upon the light and aspect, the special uses to which the rooms are intended to be put, and any special objects which may be intended to become features in their ultimate finish. The same tones of colour which might be selected as a ground for old pictures would rarely be equally favourable for water-colour drawings. In some rooms the repose of quiet tones is demanded, in others light and cheerful colouring is desirable; and whereas, in ordinary London houses, any decoration which favours the lodgement of dust is to be avoided, this condition need not be so strictly enforced in the country; hence, in the country, away from dirt and smoke, wall hangings, whether of silk, tapestry, or other stuff, may often be used, and give an air of comfort and completeness which cannot be obtained with mere paperings, beyond which, there is a play of light and colour in a woven fabric, hanging to the wall, very different from the absolute flatness of tone resulting from paint, or paper-hanging pasted to the surface. This fact has led some manufacturers, both in this country and in France, to seek to produce the appearance and effect of woven fabrics, by various methods of relieving or embossing the surfaces of their papers. Very ingenious and clever have been some of their productions, and the reproductions of ancient brocades, cut velvets, &c., by M. Balin, of Paris, are excellent examples of what enterprise and skilful handicraft can do. It is, perhaps, unfair to exclude from consideration, on the mere score of their being imitations, papers like these, which are distinctly decorative and agreeable.

In the case of the paper imitations or reproductions of the ancient embossed leathers, they must not be considered as mere imitations, because the result on the surface is, or may be made, the same in one as in the other, for it is quite as legitimate to emboss and gild, or ornament, the surface of thick paper, as that of leather or any other material.

These embossed leather papers, with their rich tones, the slight play of light from the low relief surfaces, and with their hard varnished surfaces, afford an excellent wall covering, at a cost varying from one-third to one-sixth the price of the leather. They are, perhaps, most suitable for libraries, dining-rooms, or smoking-rooms, but they may occasionally be used in drawing-room decoration with good effect.

Of course, with money, you can do anything; but I hold you may also make your rooms quite as beautiful, quite as pleasant, and quite as artistic and refined, and, perhaps, a good deal more home-like, with limited means, and at small cost. This

present age of luxury is, if anything, rather a curse than a help to true art feeling, so much is done for show and effect, and so little from the real love of the beauty and grace of real art. We do not want museums, we want homes. There are innumerable ways of making your walls beautiful with stamped leather, damask, and silk, and tones of gold and silver, ivory and ebony. Dark blue and gold, dark red and white, grey and red, chocolate and gold, all look well when harmoniously arranged.

At South Kensington, in the refreshment-rooms, there are many suggestions for interchange of colour, but all carried out utterly regardless of cost, and the walls are much too overladen and crowded with detail. Another decorative treatment of a small drawing or music-room would be by panelling the lower portion of the walls with a deal dado, delicately painted in yellowish pink or blue, and covering the general wall surface with a golden-toned paper, arranged in panels to suit the proportion of the room, with painted and stencil arabesques pattern on the dividing spaces; the frieze treated with good figure or ornamental enrichment of canvas plaster, or papier maché in low relief, painted white, with a groundwork of reddish gold or Bartolozzi engraving tint. The floor might have a border of light ebony and maple or boxwood parquet, with a low-toned Persian carpet in the centre, with easy lounges or divans all round the room for rest and comfort, the centre space being left clear of furniture, so as to allow of ample room for guests passing through to other rooms, or to congregate while listening to song or music; or the general tone of the wall surface may be of a bright bluish drab-coloured pattern paper, with a frieze of small yellowish diaper pattern, the woodwork throughout being painted in brighter tones of blue, with mouldings and stencil decoration on white, like Wedgwood china.

The examples of this kind of treatment which I have seen were quiet and pleasing, and looked exceedingly well, where the walls were lighted up with a few water-colour drawings, and here and there brackets with vases of deep red and blue "splashed" chinese porcelain. There are, of course, numerous other ways of treating the walls of a drawing-room with good taste and pleasant variety and brightness of colouring. The few examples I have quoted are merely suggestive as giving a few types of colouring and contrast. In any treatment that may be adopted, let it be, above all, remembered that the walls, while bright and glowing in colour, should have no staring patterns or design, which give at once, to the educated eye, a feeling of discomfort and unrest, and tend materially to destroy the harmony of the room.

The good taste and agreeable effect of the room will depend much upon the skill with which the wall surface is divided, and by the contrast and arrangement of the colouring and general belongings of the room. "The most harmonious proportions may easily be destroyed by an arrangement of wall paintings; while, on the other hand, the narrowest and most inconvenient spaces may often be rendered not only pleasing, but of comfortable and domestic aspect. It is in Pompeii that we learn more especially to appreciate the magic effect of such mode of adornment to walls which, makes the rooms (almost without exception small) appear much larger and more elegant than they really are. In this character of decoration, the ornamentation becomes substantial by the opposition of colours. The contrast to which white is placed to the darker tints has likewise a magical effect, causing the surface of the wall to appear, as it were, broken through. The blue, in opposition to dark red, produces the illusion of aerial perspective, throwing back the actual plane of the wall, and making it appear to retire in the distance."

All kinds of tricky, glaring conceits and eccentricities in colouring, are equally wrong in house decoration as in a lady's dress. There should be, throughout, grace and beauty of design and colour, and quietness and repose of ornamentation. The decorative treatment of some of the rooms in the Prince of Wales's Pavilion, by Messrs. Gillow, and of some of the rooms in other houses in the Street of Nations, by Messrs. Jackson and Graham, Shoolbred, Trollope, and other decorators, in the late Paris Exhibition, together with the design and execution of the various examples of furniture, were especially good; the boudoir of the Princess of Wales, by Messrs. Gillow, and the drawing-room in one of the smaller houses, being especially noticeable for delicacy of colouring and harmony of general effect. In the latter, the walls were finished in soft, delicate tones of yellow and yellowish pink, the woodwork being tinted a delicate blue colour; the mantelpiece, of good and characteristic design, being set off by tilework of red lustre ware, by Mr. De Morgan; the windows hung with light curtains of Crete muslin, printed in light shades of yellow pink; the floor covered with Indian matting, and Persian rugs of exquisite design and colouring scattered over it here and there; the furniture of satin and rose woods, with painted and inlaid panels, appropriate and good in design, but eclectic in character,—all gave a pleasant, home-like air of comfort and suitability, combined with harmony, and elegance of general effect.

In decorating a London house, you must bear in mind that dark papers and dark hangings absorb an immense amount of light, and that you can do with half the amount of candles or gas, if you keep to a reasonably light tone in your general decoration.

A dining-room must have gas, I suppose, but candles or lamps should be used in drawing-rooms, as softer and less damaging to all works of art. A glass candelabra of small size, so as not to obtrude itself, in the centre of the room, a few good sconces, with light brass *repoussé* backs or small Venetian mirrors at the back to reflect the light, fixed here and there to the walls, will be found ample for general lighting purposes.

And here let me say, the brass gaseliers now made after old Jacobean forms, are better than all the pretentious mediæval forms that have been so long the fashion. Messrs. Salviati make some pretty Venetian glass sconces and lamps, inexpensive, and fairly good.

I shall not presume to set forth any given rules for the furniture of the drawing-room. This must naturally, in a large degree, depend upon, as indeed, practically, does every other room in the house, the good taste of the lady of the house; a drawing-room may be purely eclectic in its

arrangement, that is to say, works of almost every period of art may be here collected, provided there be a general harmony of arrangement.

Simple cabinets, like the little Japanese cabinet lent me by Mr. Graham, valuable inlaid or mahogany cabinets, with their collections of valuable works, *bric-à-brac* armour, jewellery, rare china, embroideries, or whatever else may be the fancy of the owner, may well find a place in the drawing-room of the house, so long as they are arranged in some sort of careless harmony of grouping and colouring; the pleasant and judicious arrangement of these rooms, the choice of form and the assortment of colouring, so as to make up the supreme elegance of the whole put together, will make all the difference in a cheerful home-like room, which shall not only be handsome and beautiful, with numerous objects of art-work of every kind, but shall, above all, look as if it is arranged also for comfort and use. We do not want drawing-rooms to be filled with stiff, uncomfortable furniture, nor do we want museums in which we fear to walk or move about, but we want pleasant, cheerful rooms, in which the collection of furniture and objects of art, shall all tend to make the room pleasant and habitable—not a mere show-room, from which the coverings are to be removed only on some grand occasion. The floor may be painted, or covered with India matting, with good coloured rugs scattered here and there about it; the chairs and couches should, above all, be comfortable and easy; and even as the thoughts and taste of the lady occupant are given to the careful arrangement of furniture, to show off to the best advantage a piece of tapestry, a lacquered cabinet, to place well porcelain and bronzes, Persian embroidery, or Indian brocade, so as to avoid anachronisms, so will be enhanced the cheerfulness, grace, and artistic elegance of the room; for it must be admitted that "the anachronisms between two ill-assorted pieces of furniture may be as offensive to the eye as between the scattered parts of a complete set of furniture; the finest pieces of armour will assume the look of old iron, according to the background which sets them off." The present fashion of collecting works of Oriental design in china or other art work, so far assists even the uneducated, as their especial purity of taste and brilliancy of colour admit of their bearing almost every contrast. By all means have works of all kind of art surrounding you, but depend upon it your enjoyment of them will be materially increased, if they are carefully arranged and harmoniously set out.

The exquisitely beautiful satin-wood furniture of Adam's style, exhibited in the boudoir of the Princess of Wales's Pavilion at Paris by Messrs. Gillow, was, to my mind, an example of exceedingly delicate and graceful adaptation of eighteenth century design to modern furniture; the panels of the various pieces formed in walnut-wood, with ebony inlaid, and laid over with boxwood, carved down so as to show the ebony behind, in exquisite cameo-like medallions after Flaxman, the delicate enrichments and ornamentation of gilt lacquer-like character, were all exquisite in design, and marvellously beautiful in workmanship.

I am indebted to Messrs. Jackson and Graham for the loan of various good pieces of decorative furniture, which set forth some of the views I have expressed as to simplicity of form and design, and of the use of lacquer and painted decoration in panels. Let your drawing-room, therefore, be filled with beautiful objects, which need not necessarily be expensive, comfortable "causeuse" and divan seats, low tables for work or papers, cases for books, and cabinets for ornaments and china, but let there be no eccentricities or conceits, which are as bad in taste in furniture and decoration as they are in a lady's dress. Let everything tend to make the room bright and cheerful, home-like and artistic, with general grace, and quietness of design and colouring throughout.

In most London houses of any size or pretension, the bedrooms are, in a measure, sacrificed, as regards height, to the reception rooms. For the most part the best bedrooms, and these are on the second floor of the house, are rarely more than ten feet high, and sometimes considerably less, while the rooms over vary from seven feet six inches to nine feet in total height. At the principal floor of bedrooms, or second floor, the main or principal staircase ends, as a rule, and a dingy back staircase commences, running up in the centre of the house, obtaining only such partial light, as is glimmered down from the skylight overhead. In the bedrooms, above everything, it is necessary to have a cheerful, home-like look. Often in cases of illness we have to live in these rooms for days, perhaps weeks; we should seek, therefore, at all events, to make them as pleasant and comfortable as possible. It is hardly necessary to suggest that it is most undesirable to have heavy curtains or hangings anywhere, as they only tend to make the room stuffy, to collect dust and all the thousand ills that float about in the air of a London bedroom, which, like a flight of starlings alarmed by some sudden noise, fly away on the first touch, and help to cover everything with fluff and dust, adding materially to the unhealthiness of the room. Beyond all this, let those who at any time have been compelled through illness to stay long in their bedrooms, tell of the misery and restlessness caused by the perpetual shaking of the fringe or valance of the curtains overhead, which with the least movement nods and chatters like a collection of jackdaws in some ancient ruin. The old four-post bed is now almost a thing of the past. We have learnt that to shut ourselves in the limited space of such monstrosities, by close hangings and closed tops or coverings, means not only excluding light, which may not be desirable, but air, which is of the highest importance; for remember, to secure healthy refreshing rest and sleep, it is of the highest importance that there shall be a proper and sufficient supply of pure air during the hours of sleep, so that our morning waking may not find us feverish, and nauseated by the continual inhaling of impure air; and this must naturally ensue if our only supply is limited to the space inclosed by the covering and hangings of one of these ancient four-posters. A bedroom should be essentially clear of everything that can collect or hold dust in any form; should be bright and cheerful, pleasantly furnished, not with the everlasting heavy mahogany wardrobes and dingy-looking chests of drawers, but with light and cheerful furniture of good and simple design, in which everything shall be carefully arranged and

studied for use, not show. The good taste of the lady inhabitants of the house will soon add to the general home feeling of rest and comfort, by innumerable knick-knacks. I would have the whole floor of the room stained and varnished, or painted, and strips of carpet, matting, or rugs thrown down only where required; these can be taken up and shaken every day without trouble, and the evil of fixed carpets thus avoided. If, however, a carpet must be laid down, let it on no account go under the bed, or within two feet of the walls; the spaces under the bed or wall furniture would rarely be swept, and under heavy wardrobes and chests of drawers there would be a gradual accumulation of dirt and dust, until such times as the annual general turn-out and cleansing takes place. Canopies over beds, and the old-fashioned system of hangings, must suggest themselves to all of us as being unhealthy, even if some of us think they may be comfortable. Shut closely up at night, as bedrooms mostly are, we want as much free breathing space as possible, not to shut ourselves in with heavy canopies and closely drawn bed curtains. Some of you, who may perhaps disagree with my views about canopies, will perhaps take the trouble to get up and look at tho top of any such arrangement in your own room. I fancy you will be somewhat startled by what you will see, and will be hereafter more inclined to do without such dust-traps. If a room be carefully decorated, curtains are much better away, on ground of health as well as decoration. If you insist on having your room made quite dark at night, have double blinds or shutters; a thick green tammy or tussock silk blind will effectually darken any window, and materially add to the warmth of the room.

Depend upon it, from all points of view—for the sake of comfort, health, and cleanliness—you will find it infinitely better to do with as little carpet and drapery in London bedrooms—indeed, in any bedroom—as possible. As regards the walls of bedrooms, even as it is undesirable to cover the whole of the floor with carpet, equally undesirable is it—from all points of view, health, light, and decoration—to cover the whole walls with paper. As a matter of health, it is better to have as little material as possible that will absorb and retain the too often impure air of a bedroom; as a matter of light, it is desirable to have a portion of the wall, at least, of some light general tone, even if the lower portion of the wall be papered in a somewhat dark shade. I have seen bedrooms which looked cheerful and pleasant in their decoration and general appearance, where the walls, to a height of about four feet from the floor, had a dado of manilla or Indian matting stretched close to the wall, and fixed top and bottom with a small round moulding, screwed down, so as to be easily removed for cleaning behind the dado, or replacing it, when required, with new. Above this, the wall was finished with a pleasant light paper of no particular pattern, so that you could not be annoyed at night by flights of birds or symmetrical patterns of conventional primroses, daisies, or fruit, which might in any way suggest a countless and never-ending procession along the walls. Any pattern or design which shows prominently any set pattern, or spots which suggest, a sum of multiplication, or which in the half light of night or early morning, might be likely to fix themselves upon the tired brain, suggesting all kinds of weird forms, are especially to be avoided. The design should be of such a description that, saving as regards colour, it should offer no specially marked pattern. I have seen various designs for papers of high artistic character, but in which flights of birds or rows of conventional flowers stood out in bold relief, suggesting ideas of counting, or dreaming thoughts of restlessness, which, to an over-tired or restless brain, soon brings utter wakefulness. I see no reason, however, why the whole wall above such a dado should not be tinted or coloured in distemper; and, although I do not, for a moment, advocate the imitation of Pompeian work in English houses, we might with advantage adopt some of its general and very effective tones of colour and design for bedroom wall and ceiling decoration. I would suggest a dark matting dado as a base, and the remainder of the wall distempered of some grateful soft tint, with graceful pattern border and frieze stencilled on, and here and there panels formed in the decoration, with inclosing lines of bright and well-selected colours, wherein might be enframed looking-glasses, and here and there water-colours or photographs, as forming part of the decoration of the room, but not standing out of it in any too prominent manner. All this kind of work can be treated simply, and at little cost, and the distemper work can be rubbed over with bread crumb, or brushed down, and so easily cleaned. Any such scheme of distemper decoration, not necessarily of Pompeian character, but based on some simple and harmonious style of decoration, of which there are many good examples, surely is better than all the wall-papers in the world. "Imagine," as a writer on Pompeii says, "what the ruins of Pompeii would have been, had the houses been lined with our fashionable wall papers. We may form some idea of the effect they would have produced, by contemplating a modern dwelling which has been deserted for a few months, with its shabby walls hung with tattered strips, of tawdry hangings." One of the prettiest rooms I remember to have seen was finished in soft tones of distemper, in which dark-grey, red, and yellow were the chief colours in the decoration, and where a broad decorative frieze under the ceiling added immensely to the general effect.

The general woodwork of the doors, windows, and skirtings should be painted in some plain colour, to harmonise or contrast with the wall decoration, and the whole varnished; woodwork finished in this way can be easily washed or cleaned, and the extra expense of varnishing will be save in a few years. The bedstead should be of brass or iron, the furniture of light wood, varnished or polished; and, now that good printed tiles can be obtained at small expense, they may be used in washing stands with good effect, or the wall above might be lined entirely with them to a height of two or three feet.

There are now so many really good designs of wall-hangings, of subdued and harmonious colouring, that there should be no difficulty in selecting such an one. It is well to remember that the greatest artistic skill of colouring alone, can so graduate all the various colours as to confuse the eye, without attracting it to any given portion of

the design, and that, therefore, it is far safer to trust to some really good distemper colour; and this should and may well be of such an absolutely undefined shade, that you hardly know what to call it. A little thought, a little study, and a little time will be well spent in the careful furnishing and decoration of the sleeping rooms of our houses, so they may be healthy, cheerful, and comfortable.

I need scarcely say that the laws of health require that there shall be ample ventilation in all the sleeping rooms of the house, or they will get stuffy and absolutely unhealthy at night when shut up, when there are no opening and shutting of doors and windows for ingress of fresh air, and no fires for egress of foul air. Fresh air must be brought in, either by the ordinary gratings and tubes through the outer wall, or from the staircase well—in which there is generally a fair supply of fresh air, although not always of the purest kind—by means of ventilators over the doors. All this kind of practical decoration is as necessary for bodily health, as art decoration is for the mental enjoyment and pleasure, and if the one be neglected, the other may almost as well be left undone.

In the dreariness of London houses, nothing has struck me as so utterly cruel as the additional dreariness which generally pervades the rooms especially devoted to children—the nurseries of the house, the rooms in which our little ones spend so large a portion of their early lives; and yet I know of no rooms which should be made more cheerful and more beautiful in their general appearance than these. I do not mean that you are to put expensive cabinets, rare china, or even pictures on the walls. These would not be understood, and would naturally help to the discomfort of the little inhabitants, who would be told that they must not play or romp, for fear of damaging them in some way or other.

While the furniture should be strong and useful, it need not be prison-like; the walls need not be covered with some monotonous imitation tile paper, because it wears better than another. In the windows of the day nursery, there should be boxes of flowers, in which buttercups and daisies, primroses and daffodils, might be cultivated, to teach the little ones of the country, and of the nursery rhymes and fairy tales they love so well. A few shillings will buy bulbs or seeds enough to make a constant variety from spring-tide to winter, and will be a constant source of pleasure for little hands to tend, and weave into fairy chains and tresses; and little eyes will brighten in watching for the outburst of some new flower. Let the walls be papered with some pleasant paper, in which the colours shall be bright and cheerful; distemper the upper portion of the room for health's sake, and varnish the paper if you please; but now-a-days, when really good illustrations are generally, and not as an exception, to be found in so many of our monthly and weekly publications, why not, instead of destroying them, cut them out, or, better still, let the little ones do so, and paper them over the whole of the lower portion of the room; a band of colour might be made by buying some of the Christmas books which Mr. H. S. Marks, R.A., Miss Kate Greenaway, and Mr. Walter Crane have so charmingly and artistically illustrated, and by pasting the scenes in regular order and procession, as a kind of frieze, under the upper band of distemper, varnished over to protect from dirt, the stories of "Jack and the Bean Stalk," Cinderella and her sisters, of the numerous beautiful princesses and enchanted princes, and a host of nursery rhymes and tales which have been so well illustrated, may thus be used; while here and there, as varnished panels, might be pasted up the large Christmas coloured illustrations, which few Christmas numbers are now without. Why not cover the walls of the nurseries with illustrations, telling of the glories, and, if you please, the horrors of war, teaching peace and goodwill by illustrating the antitype; of the various birds, beasts, and reptiles that went into the ark; of flowers, and all other things which are bright and beautiful? All these would make the children's home a bright and cheery spot, and, in pleasant guise, teach them many things better than all the lesson books in the world.

There are some charming papers designed by Mr. Walter Crane, and illustrating some of the best known nursery tales and rhymes, which are admirably adapted for the walls of day nurseries, and are cheap enough to be frequently changed. Do not have hangings of any sort in your nurseries; they only breed disease and dust. The more cheerful and gay your nursery is, believe me, the brighter and happier will your children be. In the night nursery the walls should be all distempered, so as to be cleaned or redone at small cost at frequent intervals; for I am quite certain that here, above all things, it is essential to wash out, as often as possible, the peculiar bedroom atmosphere which must cling, in a measure, to the generally low rooms of a London upper floor; a simple dark shade of colour will offer no spots or nightmare effects, to drive away sleep, or disturb the little ones in their times of feverish unrest or illness. But in the room they live in, there is no reason why the "writing on the wall" should not be the earliest teaching of all that is beautiful in nature, art, or science; and by the illustrations of fairy lore incline the thoughts of our little ones to all that is graceful and beautiful in imaginative faculties. The knowledge thus gained, amid the smoke and dinginess of a London sky, will tend to make the annual change to the country or seaside ten times more enjoyable, ten times more instructive.

The floors of the rooms should be stained and varnished or painted all over, and a small centre carpet pinned down in the day nursery, so as to be easily taken up and cleaned; small strips of carpet or India matting laid down beside the beds will be amply sufficient in the night nursery. Let the bedsteads be of iron, and the furniture strong and useful; painted or stained deal will be found amply sufficient, and is at the same time light and cheerful. London nurseries are, unfortunately, very low, and unless the back and front rooms communicate by large folding doors, which can be thrown open with the windows—so as to allow of a thorough current of air to sweeten the rooms, when the children are out of them—there is much difficulty in securing good and proper ventilation. Too much care cannot be taken to obtain this, and large open gratings fixed over the doors, and communicating with the staircase landing, with Boyle's ventilators in the chimneys, will be found good and effective means of obtaining a large amount of

artificial ventilation. No pains should be spared to render the nurseries of the house as cheerful and pretty as possible, or to secure ample light and thorough ventilation.

To surround our little ones with decoration and everyday objects, in which there shall be grace and beauty of design and colour, instead of the commonplace and vulgar tawdriness which in so many homes is thought good enough for the nurseries, will imbue them with a love and appreciative feeling for things of beauty and harmony of form and colour; but if we wish to have healthy children, we must have healthy homes; and in studying how best to decorate the walls, do not let us forget that it is first of all imperative that there shall be no overcrowding of the generally low rooms, and that ample light and pure air are essential to their bodily and mental health and well-being.

Those who value good servants will not forget that their rooms be made bright and cheerful, and that, if possible, in one room in the basement there shall be some pleasant corner, where rest and change may be got after the daily work is done. The servants' hall or sitting-room should not be the dingy place it generally is; let it be papered with some cheerful pattern paper of pleasant colour; let the floor be painted and varnished, with a small centre carpet or matting, and the walls hung with some good photographs or prints, which are now-a-days to be obtained at small cost; put boxes of flowers in the windows, and let the furniture be strong and serviceable, but not prison-like.

In the generally dark underground passages of London houses, it is difficult to do anything with the walls to make them clean and light, unless the whole surface is covered with white Dutch tiles; but this of course is expensive, and cannot always be done, especially when the house is held for the usual short term, on lease or agreement. The upper portion of the walls may be distempered, and the lower portion painted to a height of, say five feet from the floor, so as to be easily cleaned. The servants' bedrooms should all be distempered, and the floors painted all over. The rooms throughout should be thoroughly ventilated by some such system as that recommended for the nurseries, and every means taken to render them light, airy, and cheerful.

In the bedrooms of a London house, which, as a rule, are sacrificed in height to the reception-rooms below, it is desirable to utilise every corner and recess without filling the rooms with heavy and inconvenient furniture. And although the wardrobes of the present day may combine in themselves many conveniences, they, as a rule, are lumbering and unwieldy, and occupy far too much space in the limited area of the room, besides which they are necessarily expensive articles of furniture. I would suggest that the recesses formed by the fireplaces should, in part at least, be filled in with good hanging closets, which can be screwed to the walls and removed at will. These might be made to go up quite to the ceiling, by which arrangement no spaces, such as those formed by tops of wardrobes, would be left to harbour and accumulate dust and dirt. The top portion might be arranged with shelves, whereon could be stowed away articles of dress not immediately required. The middle space could be fitted with hooks and rails, on which to hang dresses and other articles of a lady's belongings; the lower portion being fitted with sliding shelves and drawers, for caps and bonnets, and the whole enclosed in folding doors in two heights, the lower panels of which might be fitted with plate-glass, which is a necessary element in the room. All this work can very well be done in good sound deal without any frittering away of detail or ornamentation, which are utterly unnecessary and out of place, and the whole painted in some shade of colour to harmonise with the decoration of the room. Naturally, chests of drawers are required, but these should stand up well above the floor on strong or plainly turned legs, so as to be easily removable, and to allow of the space under being thoroughly cleaned and dusted. The dressing-table should have nests of convenient drawers on either side of the lower portion, while enclosing cupboards might be arranged on either side of the swinging glass, for gloves or jewellery. But above all, the mere furniture of the room, whether it be of painted deal or inlaid satinwood, should be perfectly simple in design, made for use and not for show, and free from the expensive trimmings of unnecessary carving, and rows of tiny ballusters, which are not only bad in taste, but must be terrible to those who, in times of sickness and suffering, are naturally led by distorted imagination to think them wearisome and countless. If the panels are to be decorated at all, let them be done with some pleasant drawing in monotone or deeper enrichment, which shall not suggest spottiness and crudeness to those who have to lie long hours and look upon them.

In the windows might be arranged plain deal boxes, fitted as ottomans, in which to stow away articles of dress, with soft and luxuriously stuffed seats and backs, that would in themselves suggest rest and quiet. I cannot in any way agree with the fashion which is endeavouring to revive the heavy wood bedsteads of our ancestors, whether with or without the heavy posts and top superstructure. To my mind, nothing can be better or more cleanly than the painted iron or brass bedsteads, with perhaps some light hangings, cheerful, yet subdued in colour. Messrs. Morris and Co. have been good enough to send me this evening a variety of patterns of printed cottons, and cotton tapestries, good in design and colour, and exceedingly moderate in price. If these be too sombre to your taste, I would suggest that, instead of the more expensive hangings, you should endeavour to buy some of those printed Indian cottons, called "sambars," which will give you as much colouring as you please, at a moderate cost, or some of the Indian silks with cotton back, which can, now-a-days, be bought for something less than 2s. a yard.

As I have said before, avoid carpeting the whole of your room, but paint the whole floor all over, of some dark shade of colour, and put down mats or rugs only where required. I am quite sure that this arrangement will decrease the stuffiness, and add much to the healthiness of a London bedroom, and I am sure you will accept as unanswerable the fact that everything that harbours dirt or dust, or tends to prevent the thorough circulation of air during the long hours of night, when the room is necessarily shut up, will be in every sense undesirable. The blinds of a bedroom should be of

some soft-toned colour, and not the vivid staring white and yellow to which we are so accustomed. I need not dwell further on this portion of my subject, as the cheerfulness and comfort of a bedroom is quite as much dependent upon the graceful taste of arrangement of the ladies of the house, as upon the upholstery and fittings with which it is furnished.

It is impossible, within the limits of a few short lectures, to treat in any way but cursorily of a subject so large as that I have been addressing you upon, or to speak of the hundred-and-one small items which all tend to make up the harmonious whole of a well furnished house.

In my next and last lecture, I shall endeavour to treat generally of the ordinary articles of domestic use.

In decoration and furniture, it is above all desirable to avoid all eccentricity and seeming quaintness in design, with no particular use or object, to take care that everything in furniture shall be strong, serviceable, and fitting for its particular use, and to remember that elaboration and expense are really unnecessary elements in the furnishing of a house, as in dress and decoration.

MISCELLANEOUS.

DOMESTIC ECONOMY.

Extracts from the Reports of Her Majesty's Inspectors of Schools for the Year 1879, showing the Progress made in Instruction in Domestic Economy.

"Domestic economy has been taught in 49 schools, but generally in a perfunctory and valueless manner. Here and there schools have availed themselves of the lectures given in their neighbourhood by teachers from South Kensington, with good, though I fear transient, results. In one school only in the district is practice in simple cookery for the elder girls an established part of the school curriculum. The arrangements there are so simple, economical, and effective, that I wonder that the example has not been generally followed in country schools."—Mr. Colvill, Inspector, Shrewsbury District of Shropshire, p. 242.

"The Stokesay Cooking School is carried on in the master's kitchen three days in the week for three hours in the afternoon. The girls of the first and second classes who are old enough, two at a time, are instructed in the cooking of plain dishes, such as meat pies, Irish stews, broth, rice, sago, and Oswego puddings, &c., by a mistress, whose duties also include teaching sewing occasionally, and attendance on the master. Her remuneration for these services are her rooms rent free and £12 a year. The apparatus used is of the simplest description, including merely the utensils, fireplace, and oven usually found in any good cottage kitchen. I attribute the success which has certainly attended the scheme during the last 20 years mainly to the modesty of the end aimed at, which has been to give the girls some knowledge of economy likely to be useful to them hereafter as wives and mothers of families, and believe that had we aspired to making them finished servants we should have failed. The materials used in cooking are all carefully weighed and entered in a book, kept by the girls themselves; and they are frequently examined *viva voce* on the process of making particular dishes. The food is sent to the sick and aged in the parish, and carried to them by the children who live in their neighbourhood, and the funds are supplied from the offertory in the church. The system has taken such firm root that there is no difficulty in carrying it out, and I am satisfied that it has done substantial good, by giving a practical direction to the girls' work, and in this opinion I am confirmed by those who have been at the trouble to look into it. I find that the average cost of each dish has been about 4½d., exclusive of the price of fuel."—Rev. J. D. La Touche, Stokesay Vicarage, Shrewsbury District, p. 244.

"Domestic economy is very frequently pure waste of time. It is a pity that, by a rule framed with a very commendable object (alas, too little realised !), girls are obliged to be presented in domestic economy if they take up special subjects at all. In mixed schools the rule causes a good deal of trouble, especially when they are under a master, and the results of the teaching are seldom at all satisfactory. The answers are generally dry and meagre, or absurd. If all the children presented in special subjects in the same school were allowed to take the same subjects without any restriction, there would be a better chance of something being properly learnt."—Mr. Currey, Inspector, County of Northampton, p. 261.

"Undoubtedly the most important, and, with few exceptions, the worst taught, is domestic economy. From the group of cooks I select girls at random, and give them certain dishes to prepare for me, taken from a list of some 24 or 30 with which they are familiar, generally adding a few common ones not down on their list. From the next group I tell off girls to wash, iron, clean grates, lay fires, polish candlesticks, and so forth; while the last make jellies, beef tea, &c., for sick people, or reckon up the expense of the articles required for the other groups, &c. The sight of their bright eager faces and evident keen enjoyment of their work is not easily forgotten, and forms a marked contrast to the perplexed and bored look one too often sees. In addition to the practical text, each girl also answers a few questions on paper. I am glad to say that several schools in the borough of Wakefield send the older girls to practical cookery lessons given at the invalid's kitchen, under the auspices of the Wakefield branch of the Yorkshire Ladies' Council of Education, but the great drawback to this appears to be the number who attend, and the difficulty of securing enough attention and practice for each member of the class. I hope by the time your Lordships receive the next report on this district that every town or group of schools will possess at least one common kitchen, and that the members of School Boards will think a room provided with a simple stove and the few common requisites for cottage cookery, as well worthy of attention as a handsome façade or a more pretentious higher Board school."—Mr. Dibben, Inspector, Wakefield District, pp. 277-8.

"The answers in domestic economy are, for the most part, very poor."—Mr. Helps, Inspector, Chelmsford District, p. 300.

"Economy has been taken in girls' schools with success. Some of the manuals in use have been compiled by persons who knew what they were writing about, and a result has been that teachers and children have been interested in the subject. In Exeter, lectures on cooking, given by lecturers from the Training School at South Kensington, have been attended by teachers, pupil-teachers, and children."—Mr. Howard, Inspector, East Devon and part of Dorset District, p. 305.

"The cookery classes maintained by the Board appear to be doing good service; but very few of the voluntary schools avail themselves of them. Mistresses grudge

the time, and think the walk through the streets disorganises the girls."—Mr. Moncreiff, Inspector, Bristol District, p. 338.

This is not a knowledge only of certain recipes, which at first seemed the notion of many teachers. The object should be to teach it as a science, something based on principles; to teach the reasons why this or that method is adopted, and how deducible from certain laws of nature. I am afraid it is sometimes taken up as a blind. The girls must take up this subject first, if any, but the teacher prefers "literature," hence they are presented in domestic economy and all fail, and then, the conditions having been satisfied, are presented and pass in literature. If it be intended to adhere to the rule that domestic economy must be the first subject taught to girls, then the grant on passing in any other subject should be made dependent on passing in this. Otherwise it will often be taken up as a sham subject."—Mr. Pennethorne, Inspector, Northumberland District, p. 367.

"Domestic economy is, perhaps, the most important of all the subjects of secular instruction included in the same Fourth Schedule, if it could be taught to children; but its actual position in schools is very much the same as that occupied by "literature," and for the same reason. The best answers to questions on this subject which I have read were almost verbatim reproductions of passages in a manual which the class had to learn; but, unfortunately, the interchange of the two words "infection" and "contagion" showed that the girls did not know the meaning of the words which they were using. In another school the answers given by one set of children were, with scarcely an exception, as absurd as the following ones:—"Infections are brought on by bad smells such as small pox measels scarlet fever Glass pox SC they are brought on by bad drainerges suers, they must be well ventolated." "Infection disease are caught by touching such as charcoal chlorid of lime, &C." "Measles Feaver . . . . are called disinfectionous because they are catching." "Fainted. If a person as fainted take her out in the open air lay her down with her head. And do the clothing round the neck and dashed cold water the face and hand and put smelling saults to her nose." The children in a third school wrote answers as follows:—"Degestion is paines in the head, paines in the stom-ach bad tempers." "From digestion comes consumption, information head ache neuralgia." I myself know nothing about the "culinary treatment of food" (Domestic Economy, Second Branch, Third Stage), but by the help of a friend who does, and who has been for years studying by daily experiment how to cook in the best way the simple materials on which poor families chiefly live, simple questions of a very practical character have been put to girls who are supposed to have had special instructions in this part of the subject. I need hardly say that these question have never been answered, although elaborate paragraphs have been written out about nitrogenous and carbonaceous foods. The attempts, to say anything about the practical operations in which a cook is concerned, seem to me to be in general nothing more than imperfect reproductions of recipes which have been committed to memory by the children, but so forgotten or jumbled together as to be unintelligible and useless. When children propose to make meat puddings without either meat or flour, or to boil potatoes without water, there can be no doubt that they are trusting entirely to memory in their attempts to say something about matters with which they are not practically very familiar, and get bewildered in doing so. I am not at all surprised that girls attending elementary schools make mistakes in what they say or write about the practical duties of cooks or nurses, which can be efficiently performed only by those who, having been first taught how to observe, have had ample experience in using this acquired power; but if children have had that amount of real education which I am contending for, and which well ordered schools are quite capable of giving, I am quite sure that they will avoid phraseology which they do not understand, and will express their thoughts on any subject in their own plain language."—Mr. Stewart, Inspector, Metropolitan District of Greenwich, pp. 394-5.

"Domestic economy is a most useful subject if well taught, but if, as is so often the case, the teacher is but one chapter ahead of the class in the text-book used, no possible good can arise from its study, and I wish girls' schools were not obliged to take it."—Mr. Wilkinson, Inspector, Lichfield District, p. 453.

CORRESPONDENCE.

CONTRASTING COLOURS.

In the fourth Cantor Lecture, by Mr. Edis, on "The Decoration and Furniture of Houses," occurs the following passage (*Journal*, p. 867):—

"As regards colours, bear in mind that pure red is a perfect contrast to pure green, pure yellow to purple, and blue to orange. Many of you understand the harmonious grouping of colours, but few study the causes."

The last sentence is undoubtedly true, but the causes should be studied from nature, and intelligently, not from erroneous and misleading text-books. The colours which Mr. Edis here assumes, in accordance with Field's fanciful theory, to be perfect contrasts (that is to say, perfectly complementary to each other, so that their mean colour is a neutral grey), are not so, in fact. The mean colour between pure red and pure green is not grey at all, but olive green, a shade of yellow. The mean between pure yellow and purple, and also that between pure blue and orange, are both reddish greys. Nothing is easier than to show, by the most unexceptionable evidence, that the true complementary of pure red (such as that of scarlet vermilion) is the beautiful clear seagreen of fresh verdigris, which contains as much blue as green. The true complementary of pure green (best represented by the pigment called "viridian," or by a thick wash of "emerald green") is clear pink, containing as much blue as red—the pink of the best "rose madder" is hardly blue enough. The true complementary of pure blue, such as that of ultramarine or French blue, is a pure yellow, like that of the pigment known as "permanent yellow"—that of king's yellow approaches too near to orange. The eye immediately recognises the superiority of these contrasts to those of Field's theory, and their correctness may be tested either on a rotating disc, or by the method of reflection and transmission by means of a slip of polished glass.

It is much to be lamented that the Department of Science and Art still allows the use of the manual and diagrams prepared on Field's exploded system to be used in the schools of art, and even to form a subject for examination, whilst simple natural truths about the colour sensations are ignored, and the intelligent study of one of the most beautiful branches of science, which is also most useful to art, is quite neglected; regarded perhaps as too scientific for the art classes, and too artistic for the science classes. W. Benson.

MEMBERS' SUBSCRIPTIONS.

The Michaelmas subscriptions are now due. Cheques or Post-office orders for the above should be made payable to H. T. Wood, or order, crossed "Coutts and Co."

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

BARRY'S PICTURES.

During the recess, the series of pictures by James Barry, R.A., in the Great Room of the Society, have been cleaned, and a private view of them will be held on Monday, October 25th, from 2 to 5 p.m.

Members will be admitted on signing their names.

CANTOR LECTURES.

THE DECORATION AND FURNITURE OF TOWN HOUSES.

By Robert W. Edis, F.S.A.

(*The right of reproducing these lectures is reserved.*)

LECTURE VI.—DELIVERED MONDAY, MAY 11.

General Articles of Domestic Use.

In this, my last lecture, I propose to speak generally of the many articles of domestic use which are essential in the furnishing of a house, and which should, as far as possible, be as much examples of good taste in design, and of beauty of form and colouring, as the more important works of decoration and furniture; nor can I see any reason why every little piece of pottery, porcelain, glass, plate, bronze, iron, or other work, however humble in itself, should not be essentially artistic and pleasant in form, instead of being, as it generally is, essentially ugly and commonplace. I see no real reason why everything that is made should not be beautiful in itself, or why the general articles of domestic use, in our day and generation, should not be quite as beautiful, and quite as good in artistic treatment, as any of those in the best periods of ancient art.

I am quite aware that at present it would be quite impossible to realise any such hope, as the public taste, in most matters pertaining to art, is only in a transition state, and is only gradually being improved and educated, by the examples of good art which are to be found in the innumerable collections, public and private; and thus it is willing to accept, almost without a protest, or indeed to prefer, grotesque forms or shapes, in which mere novelty and eccentricities are their only recommendation. It cannot, therefore, be wondered at that manufacturers of all kinds are willing to pander to this false taste and vulgarity, as a mere matter of trade profit and advantage; we can only hope that, as the public become more educated in art matters, by constantly being brought into association with examples of ancient art, not only in the elaborate types of decorative art and furniture, but in the commonest objects of daily life and use, they will gradually learn to distinguish things beautiful and true from those essentially ugly, commonplace, and false.

Until there is a demand for better taste in ordinary things, we can hardly expect that the manufacturers themselves will go out of their way to provide it, but will content themselves with pandering to the perverse fashion of the day, and to the insane and vulgar striving after mere novelty and eccentricity of design and form. So long as people of wealth and supposed good taste are content to people their rooms with porcelain monkeys, pug dogs, cats, and birds, and other monstrosities of similar kind, we can hardly expect manufacturers to attempt to guide them into more sober and less expensive tastes.

There is no real reason why simplicity and grace of form should be more difficult to obtain in pottery, china, glass, and other objects of daily domestic use, than the extraordinary productions which are offered for sale in almost every china, glass, or other shop, except that the latter are more profitable to the maker, and require less thought and study at the hands of mere manufacturing designers. I was told, a few days ago, by an eminent manufacturer, that he was obliged to produce for the million, and that he could not live if he did not do as other makers did, provide the articles of form, and shape, and colour which I condemned, and that mere good artistic designs did not pay. I could only answer that there are one or two artist tradesmen who do make it pay to sell only good things; and that in the time when Messrs. Wedgwood employed Flaxman, all their designs in pottery and china were good in form and ornament, from the most elaborate vase to the humblest plate or cup. What beauty can there be in bulbous vases, supported by primroses and cowslips, the roots of which are matted together to form the feet? or in the hosts of objects in pottery, glass, or porcelain, of similar character, in which the design is contorted into all kinds of extravagant forms and shapes?

It is satisfactory to notice that many of the best potters and glass-makers are endeavouring to teach the public to appreciate quieter and more simple taste, by introducing into their works imitations of good ancient forms, or in obtaining real good designs from artists, who are artists and not mere trade designers, and thus producing works in which graceful simplicity of treatment, beauty of outline, and artistic skill in ornament and decoration, are especially noticeable. In the works of Wedgwood, aided as he was by an artist of the highest ability, Flaxman, we find examples in charming ware, delicate in tone and colouring, and of the most refined classic treatment, with infinite beauty of design, form, and workmanship; and I am glad to find that this well-known firm are falling back on their old models, reproducing Flaxman designs, and, as a consequence, offering to the public not only works of great beauty and elaboration, but ordinary breakfast, dinner, and tea services in which the old forms and shapes are preserved, all

of which are infinitely more beautiful than the more modern productions. I am indebted to this firm for the loan of several examples of their ware, old and modern, and can only express a hope that they will be content to produce only such things as are good in form and design, and thus maintain the high position and rank among potters to which they long since attained. The general shapes of the examples shown here to-night are purely true potter's shapes, and not those which suggest that they should be executed in cast-iron, *repoussé* brass, or chased silver or gold, in fact, anything but clay; they exemplify, moreover, what I have been throughout advocating, that good things may be cheap things. This is especially noticeable in the specimens of breakfast and dinner services, and bedroom ewers and basins, which are generally good in shape, decoration, design, and colouring, and all to be obtained at exceedingly moderate prices.

The copy of the Portland vase, and the *plaques* of pale blue and white, and black and white jasper ware, from Flaxman's moulds, show the general excellence of handicraft in the work of this firm.

Messrs. Minton; Doulton and Co.; the Royal Worcester Porcelain Manufactory; Messrs. Osler; Webb, Powell and Co., and other manufacturers have, respectively, in their specimens of pottery, porcelain, and glass, spared no pains to improve the design and manufacture of their various wares, which show an immense progress in skill of manipulation and good artistic treatment.

From the earliest times, the work of the potter has, in a great degree, marked the progress of civilisation and the art knowledge in all nations. The very plastic nature of the material, which, under the potter's skilful hand, was moulded into various shapes and forms, offered, perhaps, an incentive to artistic imagination, not only in the lines and shape of the mere material clay, but in the decoration with which it was ultimately adorned.

The history of the art is of the highest interest, as offering not only an insight into the various skilled work of the manipulation, and mixing of the clay, but also as giving important proof of its early use and antiquity.

In the tombs of Thebes, dating about 2,000 years B.C., have been discovered drawings, showing the potter at work kneading, balling, and throwing the clay, and it is a curious fact that, until quite recently, this latter part of the work of the potter has been almost identical through some thousands of years, except that in this century the motive power of machinery has been brought into use instead of hand labour.

To a certain extent, too, the same system of decoration—varying, of course, materially in treatment, and skill of drawing and colouring, as the intelligence of the world progressed—has been carried out.

Throughout all ages, the potter's art has taken high rank in the manufactures of nations, and many distinguished poets, historians, and philosophers have been handed down as eminent in the art, while, from the days of Phidias to those of Flaxman, eminent sculptors have been associated with the potter in the making of models and designs. In the various national museums throughout the world, are preserved many exquisite specimens of pottery, in which the interest of the historic and mythological stories, worked in their decoration, is combined with grace and beauty of form.

From the tombs of Etruria and Pompeii, from the burial-places of ancient Britons, many interesting specimens have been gathered, all telling of the early use of pottery. In early mediæval times, many architectural monuments were adorned with specimens of the potter's art, and the works of Luca della Robbia, sculptor, goldsmith, and potter, are amongst those which are most valued. In Italy, the lustre ware of Gubbio, Urbino, and Faenza—which Mr. de Morgan is so successfully endeavouring to imitate — the delft ware of Holland, the exquisite *faïence* of Persia in the Azulejos of the Alhambra, and the so-called Rhodian ware, and the marvellous examples of *faïence* and porcelain of China and Japan, and, in later times, the works of Sèvres and the best of our own English potters, have all been equally sought for and prized as gems of artistic production. While we are glad to pay large prices to secure examples of any of these artistic productions for our cabinets, or for the decoration of our rooms, we might surely insist that the things we use daily on our tables, or the commoner ornaments or vases which we place on our mantelpieces, for use and show, should be, in some slight degree, a reflex of those ancient examples which we prize so much, not only for their intrinsic value, but for their artistic beauty. Without copying their individual peculiarities, we might learn, from their general exquisite form and design of ornament and decoration, some lessons for the treatment of similar articles in our own day and generation, so that we might eventually be able to produce, not only articles of luxury, but the commonest objects of every day use beautiful in form, good in colouring, and graceful in design and decoration.

Many of the best firms are, I am glad to say, turning their attention to these common objects, and are producing, every day, breakfast, dinner, and tea services, combining excellence of form and workmanship, with delicacy of colouring and moderation of cost. In the commoner objects, however, there is yet much to be desired; a dish or bowl, good in shape, is often utterly ruined by some vulgar piece of ornamentation, or handle of coarse and vulgar form and shape, or by crude enamel colouring, which chips and breaks off with the least knock.

It is questionable whether the taste which produced many really beautiful examples of pottery, *faïence*, and porcelain, contributed by some of the leading English firms to the late Paris Exhibition, and illustrating, to a great extent, mere attempts at copying or imitating Oriental and European designs and colours, is right in principle; quite certain it is, however, that English artists can never imitate that delicacy of drawing and *finesse* of design and decoration so peculiar to Oriental art, in which, by a few dots and seemingly careless touches, infinite beauty of effect is produced. The Oriental artist never painted two flowers alike, but varied their design with infinite grace and beauty of everchanging ornament, whereas the English and European artists, if they do attempt irregularity at all, show a manifest method in it, as utterly unlike the real thing as modern "blue and white" is from the old work of the same kind.

Messrs. Doulton & Co., of Lambeth, have of late years laid themselves out with great success to produce terra-cotta work and pottery of good artistic character for architectural ornamentation. In the stone ware, known as "Doulton ware," they have been eminently successful in producing work, not only good in form, but very beautiful in decoration, design, and glazing; thanks chiefly to their having secured the services of skilful artists and designers, foremost amongst whom are Mr. George Tinworth, whilom pupil and student at the Lambeth School of Art, and Miss Barlow, whose designs and ornamentations of the various works executed under them by Messrs. Doulton, are especially good in modelling, design, and decorative treatment.

This ware is practically the treatment of pure pottery clay, in the same manner as the system known as *pâte-sur-pâte* in porcelain, the art of painting with clay upon clay, by which great beauty and artistic character of decoration is obtained. The especial characteristic is perhaps the beauty and depth of the glaze, which is entirely obtained by the decomposition of salt in intense heat. The various tints required are painted on the clay before firing, and the uncertainty of the firing and glazing prevents any two pieces being alike; the manufacturers themselves hardly knowing what will be the result of the firing, and only arriving at a general idea by the known effects produced.

Messrs. Doulton have been good enough to lend me various articles *de luxe*, and for domestic use, to illustrate this portion of my lecture, and I cannot speak too highly of the improvement shown therein, in form, outline, and decoration.

In the present day, painted tiles are largely used, not only for wall decoration, but in the design of very many articles of furniture. All this kind of work may well be taken up by women, anxious, if possible, by some honourable means, to gain a livelihood in the world, provided they will give a fair and proper study to the theory and practice of the art, and not look too lightly on the study and application necessary to produce any really good work, by doing which they will assuredly fail in producing any satisfactory result.

By a careful study of natural objects, or even mere skill of adaptation of good designs, much may be done by any lady who has fair taste and skill in drawing, and the knowledge of colouring necessary to produce really good decorative work on china. With a little thoughtful labour and care, women may paint decorative tiles for any ordinary purposes, and may, if they are content to labour diligently to produce good drawing and harmony of colouring and design, make it a work of profit as well as of pleasure. In every garden there are innumerable flowers, which can be arranged, naturally or conventionally, for tile or china decoration; these should be drawn in outline, and slightly tinted in one or two colours, so as to be easy of production; for it is well to remember that the million will gladly buy simply painted tiles, or china ware, for decoraative purposes or use, if well drawn and good in design; where the few only can afford to purchase, at any remunerative price, the more elaborate pieces of painted *faïence* and porcelain, which are the result of long years of labour, and infinite knowledge, gained by much patience and innumerable failures.

There is no reason why this kind of work should not be taken up by numbers of women, who are anxiously seeking to find some remunerative use for their artistic talents; too often, however, they are not content to follow out the simpler work, but aim at producing elaborate paintings, often more or less adapted from inferior copies, and thus, as a rule, invariably fail from insufficient knowledge or want of power in drawing and design. This is more especially noticeable in figure work, which requires years of close study and drawing from nature, before any real excellence can be obtained.

The aim of all true art should be to produce good work for the million, and thus gradually to oust out all that is bad and ugly, by bringing into common every-day use things beautiful and artistic in colouring and design. It is easy to produce elaborate and costly works for the few collectors who may care to purchase them, but it is infinitely more satisfactory to make good work, which shall be within the reach of all classes of the community. I am indebted to my friend Miss Spiers, who is an artist in every sense of the word, for some excellent examples of artistic design and colouring in painted plates and dishes, which, through her kindness and courtesy, I am enabled to exhibit to-night, as illustrating this portion of my lecture, and to Messrs. Minton for some excellent examples of cheap hand-painted and printed tiles, suitable for the lining of fireplaces, ordinary panels, wash-hand-stands, and other every-day purposes, many of which can be bought from 1s. to 2s. 6d. each.

Dr. George Birdwood, in a lecture lately given in these rooms, very aptly drew attention to the causes which, to a large extent, are enfeebling and corrupting the artistic character of Indian pottery, and many of his remarks may justly be applied to all other pottery and porcelain of the present day, insisting, as they did, on beauty of form, delicacy of surface, and gracefulness and proper subordination of ornament in all articles of domestic use.

In the examples of pottery, *faïence*, and porcelain, of all countries, of all dates, up to the last two centuries, as a rule, we find beauty of outline, comeliness of form and decoration, and harmony and moderation of ornamentation and colouring, not only in the more elaborate objects, but in the smallest and most unimportant pieces of domestic ware; why, therefore, cannot we have now-a-days all things more or less beautiful and truthful in design and treatment? If only the manufacturers and their designers would seek to copy the simplicity of ancient forms, rather than to strive after the production of grotesque novelties in shape and colouring, then might we hope that everything in daily use should be more or less true in taste, correct in drawing, and beautiful in form.

It is hardly necessary to assert that grace and beauty in design need be no more expensive than ugliness and eccentricity, and that education in artistic matters, combined with a study of all that is graceful and beautiful in the best periods of art, can alone help us to that refinement and innate truth and elegance of design, which should guide us in the humblest as in the most elaborate pro-

ductions of pottery, *faïence*, and porcelain in the present day.

In these days, much anxiety is rightly shown for providing work of brain, eye, and hand, in which the tenderness of touch and true feeling of taste of the female portion of the community may be utilised for the general good of humanity, and as a means of livelihood to themselves. In painting on china and artistic embroidery there are, I contend, ample opportunities—at once legitimate and useful—for their skill and taste, which may be used to the advantage of the public, and to the profit of themselves.

In the present fashion for art-needlework, there is excellent opportunity offered for ladies to take up work which is especially their own, and which, rightly carried out, lends itself essentially to good decoration in the various hangings and coverings so necessary in all houses; but here again there seems to be something wrong, either in the training of those who learn their art at some fashionable school of needlework, or in the taste of those who make the designs, for the work which is offered to the public is not always artistic, and too often is filled with too much elaboration of detail and ornament, involving infinite labour and infinite expense.

I have had recently worked for me by a lady, who has devoted some portion of her time, for various reasons, in part to art-needlework, some excellent curtain borders, in crewel work, in which the arrangement of natural flowers into a sort of conventional pattern, necessary for the treatment of a narrow curtain border, was carried out in a highly artistic and satisfactory manner. But then the worker was practically an artist, who, instead of copying bad examples out of a book, or some stereotyped pattern of decoration, went into the garden or the field, and copied in one case sunflowers, sunflower buds, and leaves; in another flowering rush and corn flowers; in a third, *Tritoma uvaria*, or what is commonly called "poker plant," and arranged the design practically as she worked, so that no one yard of bordering was exactly like another; but the whole was harmoniously and gracefully treated, and the brilliant colouring and true artistic rendering in the work, thus rightly treated, assisted much in the general effect of the room; the cost, exclusive of materials, was a guinea a yard, a marvellously reasonable price for real art work, which, with care, may last for generations, and be always beautiful. But it is useless repeating, in crewel or *appliqué* embroidery, Japanese designs or elaborate arabesques not adapted in any way for such work. There are innumerable ways in which this really artistic embroidery can be made eminently decorative and eminently useful for all kinds of coverings, hangings, and for dress, and I should gladly see it more largely used; but the proper rendering of embroidery and *appliqué* work is as much a matter of artistic training as painting, or any other work of the kind, and we are apt to be disgusted with the many poverty-stricken attempts of young lady amateurs, who offer us, for natural effects, the stiffness and ugliness of conventional forms on chair coverings, dresses, and antimacassars, and to hesitate before suggesting work of the kind, for fear that it should be, not only extravagant in price, but unsatisfactory and unartistic in design and treatment. With good taste and artistic skill, embroidery of all kinds may be largely used to beautify and enliven our rooms.

We are told that the holy robes of Aaron were bordered by pomegranates of blue, and purple, and scarlet, intermingled with bells of pure gold; and in every museum in the world, and in many an old house, there still remain examples of ancient embroidery, eminently beautiful, the work of many a noble lady, and many a devout *religieuse;* but with everything else in the seventeenth century, embroidery became debased in taste and workmanship. Now that it is being so largely taken up again, it is well to remember that, to be good, the design, drawing, and work, must be the work of one head and one pair of hands; and for true artistic rendering, Mr. Ruskin's precept, "that the first condition of an ideal work of art, is, that it should be conceived and carried out by one person," is more or less essential.

We pride ourselves, now-a-days, on the general purity and excellence of our English glass, and yet, how often do we see the most beautiful forms utterly ruined by inartistic engraving and cutting, or coarse and crude colouring. It is not necessary to describe the many uses to which glass, in all ages, has been applied, whether in the mosaics of Pompeii, or the elaborate Roman glass engraving, such as the marvellous gem-like work of the Portland vase—of which an exceedingly good copy is exhibited here to-night by Messrs. Wedgwood—or in the elaborate designs and skilful workmanship of the Byzantine enamelled and gilded glass, or in the exquisite examples of Venetian filagree work, in which great elegance of form and infinite variety of colouring were combined with the highest skill in handicraft and design.

In the numerous modern examples of Venetian glass, there is much that is graceful and beautiful in design and treatment, but, unfortunately, the influence of bad designs, and a craving after so-called novelty of treatment, is doing much to damage otherwise beautiful work, and modern requirements are falling foul of ancient traditions; and in glass, as in china, we are seeing imitations of work essentially suggestive of other materials, and utterly subversive of true artistic treatment.

In purity of material and skill in production, glass makers can, to a great extent, hold their own with the workmen of any period of the art; but, unfortunately, with this skill of handicraft there is a manifest deterioration of design and artistic treatment, which would seem to arise from absurd attempts to produce in glass objects and forms utterly inconsistent with the true use and rendering of the material, and quite inconsistent with its real use and purpose. In glass, as in pottery, queer and grotesque forms, coarseness and bad elaboration of ornament and detail, are taking the place of graceful charm and beauty of form, which the peculiar delicacy of the material would seem to suggest in its proper treatment. By all means let us reproduce old Venetian forms, and put into modern glass all the delicacy of colouring and shape, peculiar to the best works of ancient examples, but in the interest of art, of common sense, and practical use, let us avoid all extravagant forms, which are not only bad in art, but costly in make. Table glass should be as pure and

as simple as possible, delicate in shape and ornamentation, inexpensive and fitting.

It may be a triumph of mechanical skill to produce a throne or a buffet in solid glass, but surely utterly inconsistent with the real use of the material; and while it is legitimate to employ the highest talent in producing such elaborate and eminently artistic designs of engraving, cutting, and modelling as the examples shown by Messrs. Webb in the late Paris Exhibition, surely it is utterly out of keeping with the real purpose of the material, which is at once brittle and risky to move without extreme care, to employ it for furniture stands and other works of the kind. In table glass it is essential to have elegance in form, combined with purity of decorative treatment; and we may well be thankful for the revival of the art of the old Venetian glass workers, which is giving to us, for every-day use, table glass, ornamental and useful, chandeliers, sconces, and a host of similar objects of great excellence in design, great beauty of form, and moderation of cost.

Far be it from me to advocate in any way the more extensive use of foreign made glass, to the detriment of our own English ware; but I cannot help feeling that a dining-table looks infinitely more cheerful and more artistic, when covered with water bottles, flower vases, and glasses of variety of colour and form, than with the cold monotony of ordinary English glass, no matter how pure its crystal, or how elaborate its cutting. The present fashion for colour and variety in glass, as well as in everything else, is inducing English manufacturers to turn their attention to similar work; and Messrs. Powell, of Whitefriars, and other manufacturers, have produced many exceedingly beautiful specimens of artistic glass. But to the humble glass-blowers of Murano, whose forefathers, for six centuries, largely contributed to the prosperity of Venice, spreading the glory of its name to all parts of the world, must be conceded the prize for innate beauty of form, colour, and ornamentation, and for infinite variety of all kinds of table glass, in which, although there is not the same technical excellence of skill and manufacture as in the old work, there is for the most part general artistic treatment, purity of form; and what is infinitely more to the purpose in these very practical days, it can be bought at a price which bears favourable comparison with any glass in this country, especially made for domestic purposes.

In English glass we see great variety of forms, many exceedingly graceful and good, great excellence of cutting and engraving, and occasionally some fairly good specimens of coloured and gilt glass, but we look in vain for anything which may compare with the exceeding elegance and high artistic character of the old Roman or Venetian glass. Quite recently, attempts have been made, with some success, to revive the old Roman practice of placing a thin film of gold between two layers of glass, and to overlay one colour with another; and, by cutting, to produce a cameo-like effect in the ornamentation. But we have yet much to learn before we can, in any way, notwithstanding all our supposed greater knowledge and higher education of the working classes, attain to that perfection of skill and beauty of form and ornamentation which are so noticeable in all the old glass. There is no reason why our glass should be made heavy with red lead, for the purposes of giving increased brilliancy to it when cut; we can have the same lightness of material as the olden glass, and ought to be able to produce the most elaborate designs and the simplest forms for every-day use equally well, and at reasonable cost.

In the last Paris Exhibition, Messrs. Powell and Son, Messrs. Webb, and Messrs. Osler showed collections of glass of high excellence, exhibiting marked progress and improvement in design and workmanship. But what we want now-a-days, is that our manufacturers should give us good general forms for table use, sconces, and candelabra for ordinary rooms, of common sense and artistic design, and vases, bowls, and dishes, for ornament and use, of really good form and ornamentation, at a price that shall be within the reach of us all.

In the lower sitting-rooms of most London houses, it is necessary to have some sort of lower screen or blind, to render the rooms fairly private from the gaze of too curious passers-by. For this purpose, all kinds of contrivances have been carried out, from the old wire gauze blind, with its general dirty and dingy look, and everlasting painted ornament of Greek fret or honeysuckle border, to the curious twisted cane inventions, which are bad in design, and infinitely too spotty and strong in colour to be pleasant accessories in a room in which artistic decoration of any kind is thought of. Instead, therefore, of these coarse and unsatisfactory arrangements, I suggest that either a pattern of good diaper, or other ornament, be done on the lower portion of the window-glass, by the ordinary means of embossing, or that a second sheet of glass containing the pattern—which may be done in slight tints—be fixed on the inside face; or better still, have blinds of what is called jewelled glass in square quarry lights, or good figure or flower decoration in leaded glass, either done in outline, and stained in delicate tones of yellow, or worked out in good stained glass of various colours; these can be made to any height, and fixed inside the sash, so as to be easily removed for cleaning purposes. All this kind of work can be done at the cost of a few shillings a foot super, and will add materially to the charm of the room. Blinds fixed to the sashes in this way may be objected to, on the ground that the sash weights will have to be altered to carry the extra weight of the blind, and that when the lower sash is opened, the use of the blind is practically done away with; but the first objection may be got over at the price of a few shillings per window; and if flower-boxes are fixed on the sills outside, made of ordinary zinc, with blue and white tiles inserted in the front, at a cost of from 15s. to 30s. each box, not only will the latter objection be done away with, but the bright and cheery look of low shrubs in winter, and many-coloured and scented flowers in summer, will add materially to the pleasantness of the room.

I am quite aware that I am offering no new suggestions in these remarks on blinds and flower-boxes. I am simply advocating their much greater use. For, beyond the pleasure to yourselves in the pleasant outlook upon bright flowers, the colour of the tiles and flowers would be grateful spots of life and colour in the dreary monotony of our London streets. All this kind of arrangement will

be found much better than any kind of separate blind, made in a frame and fixed with bolts to the sash-beads, which are troublesome to take down and often in the way, especially when flower-boxes are set outside as I have suggested.

In all kinds of silver, electro-plate, bronze, brass, and ironwork in the present day, there is generally an utter want of taste, in form, artistic design, and general treatment. We have been inundated with specimens of almost every description of metal of the worst possible taste, and often of cheap and inferior workmanship, for which we are largely indebted to the manufacturers of Birmingham, whose goods, for the most part at once bad in taste and cheap and trumpery in execution, have obtained the justly opprobrious title of "Brummagem," signifying, I take it, all that is nasty, cheap, and inferior; mind, I do not include, in this sweeping condemnation, the works of Messrs. Elkington, and other manufacturers of similar standing, who have done their best to produce metal work of great artistic merit and great perfection in manufacture; but it is miserable to see on our tables the trashy cruet-stands of ugly form and ornamentation, and the hundred-and-one articles in the shape of *epergnes*, cups, vases, tea and coffee services, candlesticks, and ornaments of all kinds, utterly devoid of all good artistic character, commonplace in design, and eminently trashy in execution and make; or, to see in our rooms the commonest and most trashy arrangements in the shape of door handles, and cast brass bell pulls, which are always coming off or breaking, to our personal discomfort and continual expense in replacing.

There is no absolute reason why most of these articles of domestic use should not be made good in form and shape, honest and strong in construction, at the same cost as that now paid for them, except perhaps that the manufacturer will not take the trouble to procure two or three really good designs, or to copy some of the exquisitely beautiful forms of ancient examples, and work only upon these models for general cheap things; perhaps, even if he were willing to do this, he might well answer that the public would not continue to buy of him, and would demand in his work, as of most other trades, continual novelty and continual change at the lowest possible cost.

I cannot help believing that both arguments are wrong; a vast proportion of the public are able to appreciate good forms when they see them, and many of them are willing to pay high prices for old silver of artistic design and shape, and would, I am satisfied, prefer to have, as far as possible, all these small necessaries of daily use equally good in shape and ornamentation, and to pay a fair price for the better article, rather than have the same things bad in form, and altogether unartistic; provided always that, having regard to better quality and sounder construction, they could get them on equal terms as regards price. Unfortunately, as a rule, this is not to be done, for the manufacturer naturally answers that things artistic in character demand much higher skill of handicraft, more careful execution, and therefore higher cost of production, and that he cannot, therefore, produce them without adding to the price charged for the ordinary commonplace productions of similar character, or else materially lessening his profit on the transaction; and this we, a nation of shopkeepers, can hardly expect him to do.

I combat this, by saying that the higher education of all workmen and the constant opportunities given to them, of seeing and studying good work of all kinds, should, if they have any real heart in their work, imbue them with the same kind of artistic feeling, as was evidently in the hearts and heads of the old workers, and that it should be as difficult—with real love and regard for their work and knowledge of true form—for them to produce ugly things, as it would seem now-a-days for them to produce beautiful ones.

I am quite aware that all this kind of argument may sound Utopian, and that I may fairly be told that, in ancient days, the workmen were surrounded with refinement and art work of the highest type, in great things as well as in small, and that they worked practically under totally different conditions to what they have to do in the present day; but, on the other hand, in olden days the workmen took infinite delight in the work that they did; it was a source of pleasure and of emulation; high art and industrial art with them were synonymous terms; and whether we look at the marvellous examples of gold and silver filagree and chasing, *repoussé* copper work, modelled bronzes, and plate of all descriptions still left us of the ancient Greek and Roman periods, or at those of the early mediæval times under the Gothic kings, or at those of the later days of the Italian Renaissance, we notice throughout infinite beauty of form, delicacy of work, and the highest skill of handicraft; and it must be borne in mind that all these treasures which from time to time have been brought to light, were, as a rule, nothing more than objects of household and domestic use.

I contend that there was in the workmen of past days an innate feeling for beauty, a skill of eye and hand, and an education of mind in the rendering of everything that they set their hands to, which, alas, is utterly wanting in the great majority of ordinary workmen of the present day. We pride ourselves on a higher state of civilisation, a greater freedom of life, and surround all classes of the community with protecting laws, and a high educational system. We have before us thousands of the most beautiful examples of the best periods of art work of all kinds; this age of steam and luxury is constantly bringing before us the best works of all the countries of the world, and offering encouragement in every possible manner for the production of high artistic objects for every day use, and with what result? With all our advantages, all our opportunities, all our wealth, and all our education, we are living, to a great extent, in the absolute lowest depths of ignorance in most matter of art, so far as beauty of form and power of design, or even of adaptation is concerned, in the commonest objects of daily life.

It is quite true that, in these last few years, there has been great progress made in many trades cognate to art, in the so-called industrial arts of the country, but it is at present but a feeble glimmering of that far-off light of love and truth for art's sake, which I hope may some time shine forth as strong, in all works of handicraft and artistic skill, as it did in the centuries that are past.

To my mind, the influence of trades unionism is

asserting itself in a large degree to the detriment of English work, and to keeping up extravagant prices for ordinary articles of domestic use; it is simply absurd that all the various kinds of so-called art work, whether in decoration, furniture, or other work, should be paid for at a set price, no matter what difference there may be in the skill and quickness of the workman employed, and that work should be paid for to all men in like proportion, whether well or badly done. We have only to look at the various art work imported into England to see that it holds its own with, and often surpasses, the work of British manufacturers, and, withal, is much more artistic and much less expensive. Now-a-days it would seem that the grand old saying, "Whatsoever thy hand findeth to do, do it with thy might," is changed into "Whatsoever thy hand is paid for doing, do it as slowly as it is permitted, and have no care to the might or the skill to be displayed." As far as I read it, trades unionism, by reducing all men to a great extent to one level, and by controlling to a great degree the amount and quality of the work to be done, is degrading and demoralising to the true workman. Competition in the world will and must, in the nature of things, increase, and if he look not well to it, the British workman, unless he learns to think and act for himself, and to throw off the burden and tyranny of trades unionism, will find himself beaten in the race. Let men be paid according to their skill and power of work, and they may be quite assured that all masters will gladly pay well and liberally for high skill of handicraft and honesty of labour, while the inferior men will naturally find the level; to which inferiority, whether in labour or material; naturally tends; then might we hope for that fraternity and fellowship of interest and labour which gave, as Mr. Ruskin says, to our old buildings, that "distinct and indisputable glory, that these mighty walls were never raised, and never shall be, but by men who love and aid each other in their weakness; that all their interlacing strength of vaulted stone has its foundations upon the stronger arches of manly fellowship, and all the changing grace of depressed and lifted pinnacle owes its cadence and completeness to sweeter symmetries of human soul."

I do not think that the general public is so wanting in common sense, as not to know that good engraving, or, indeed, any kind of ornamentation of silver or other metal work, can be obtained without much cost of time and labour, and, therefore, must be paid for; but why cannot we have in the ordinary tea and coffee services, and the general articles of table use, whether in silver or electro-plate, or in bronze ornaments, brass and iron door plates, bell handles, gaseliers, candelabra, sconces, and other work of the kind, good form and general artistic character, instead of the commonplace and trumpery cast and wrought work, of grotesque and ugly form, which is now offered to us.

In silver and electro-plated work, the elegance and simplicity of some of the seventeenth and eighteenth century examples might well be copied, at no greater cost to the manufacturer than the grotesque shapes and badly executed and designed chasing and engraving now produced.

Instead of the so-called mediæval "coronæ," and elaborate wrought and twisted brass and bronze gaseliers and brackets, utterly out of place in almost any house or room, and, generally, extravagantly dear, why cannot we have the simpler forms of the later Jacobean days, in which use and suitability were the prominent features of the design.

Brass-work gets dull, and iron and bronze rusts or corrodes in London atmospheres. The simplest forms, therefore, will be found most serviceable and satisfactory, and it is better to have the plainest objects which are good in outline, and fitted for the purpose, than elaborate forms twisted and curled into all manner of curious shapes, which may be called "mediæval" or "Queen Anne." Good brass *repoussé* sconces, fitted for gas or candles, can now be procured at moderate cost, and can be kept clean much more easily than the many-twisted and scrolled brackets which are generally used. Good wrought-iron work may be used for brackets, if left rough from the hands of the smith, and merely kept oiled; or some of the simpler sconces and candelabras, which can be fitted for gas, are now made by Messrs. Salviati and the Murano Glass Co., and these have the advantage generally of being graceful and artistic in form and colouring, and can easily be washed and cleaned. In all these kinds of artistic articles of domestic use, which are necessary in every house, choose those which are simple in outline and free from useless and expensive scrollwork, or engraving of bad conventional or naturalistic form. The plainer all the service of the table and the generally useful fittings of a house are, the better will they be in taste, more easily cleaned, and much more lasting than those in which elaborate ornamentation, whether in mouldings, stuck-on ornaments, or elaborate engravings are piled up for show, not for use. Do not have on your tables *epergnes* representing palm-trees with a camel grazing, or a knight in armour sheltering beneath it, or metal-work of any kind made after the form of baskets, barrels, or other equally incongruous design.

If you will examine any of the bronze or brass-work of past times, you will find that the forms are good in outline, the ornament exceeding delicate in treatment, forming part of the design, and not elaborately constructed and laid on, quite regardless of the construction; and while many pieces are elaborately adorned with beautifully-modelled figure or other enrichment, there is always great grace and beauty of form, and eminent truth of construction; and I confess I see no good reason why we should not have an equally good character of work, in all ordinary objects and articles of domestic use and furniture now-a-days; nor why, if manufacturers are asked to carry out the design of an artist in which there is no more, and possibly not so much, work as in a similar piece of work out of their own stock, they should immediately put an enormous per-centage on the cost, except that they, by this, admit that they are employing machines, and not artists, and that they will not in any way strive to leave their ordinary grooves, or to make themselves acquainted with work of the best periods of art, so that they may direct their workmen in the right principles of artistic design and execution.

In concluding this series of lectures, I would again insist upon the fact that all true art should be the practical rendering, in good taste and in

pleasant guise, of all the absolute necessities and requirements of modern life, and that all domestic art is false and bad which ignores the purposes for which the furniture, decoration, or general belongings of a house are to be put.

First of all, it is necessary that use and fitness should be the special attributes of the general furniture of our houses; but I hold that there is no necessity that practical common sense in the requirements of our houses, should in any way interfere with good artistic treatment, and that everything may be, and should be, truthful and beautiful in design, form, and colouring.

If, however, we start from the false idea that art means quaintness, eccentricity, and the elaboration of curious forms or extraordinary colours, and that great elaboration and cost are its necessary adjuncts, we shall never really progress; we may assist in bringing in a fashion which shall die, as all fashions do, and be as fickle and as fleeting as all fancies of an hour, founded only on idle thought or caprice; but we shall never attain to that higher education or knowledge which intuitively brings with it an innate love for things beautiful and true, and which deprecates at once anything that is vulgar or commonplace.

If we are content to accept only as a fashion of the day the more artistic rendering of our rooms, and, without consideration, to follow indiscriminately in the routine style of decoration and furniture which may for the moment prevail, we shall in no way have any real pleasure or delight in the work that is done, but shall live rather in dread of the time when a new style, a new fancy and fashion, shall be brought in, and when we shall have to follow, like sheep, the new order of the day.

I do not believe that things beautiful and artistic need necessarily be costly, although, I, of course, admit that all works which require a great amount of skill and time in their production, must of necessity demand a proportionate amount of payment for the time and labour involved; and I should as soon seek to do away with the production of the more elaborate works of art in the present day—some of which may indeed be the work of years—as I should ask for the suppression of the exquisite examples of ancient art, of great elaboration and costliness of design; but all these are to a great extent luxuries, and not necessities, and will be in all times be produced to satisfy the requirements, and the higher artistic culture, of those who delight in surrounding themselves with articles of luxury, and of the highest beauty in art. I have, in the lectures I have given, attempted rather to dwell upon the practicability of having good art in every-day life, and in every-day things, and to point out, to the best of my ability, the means by which this may be obtained at a moderate cost, rather than to enter upon the subject from any point of view in which money is no object.

I have not pretended, nor do I pretend, that all my views are correct; we are all students, and with the true artist and real student, our study ends only with our life. I have endeavoured to point out, in, I hope, a practical and common-sense manner, how your homes may be made more cheerful, more beautiful, and more artistic, at moderate cost. And I shall be satisfied if I have set anyone of you thinking more earnestly and more seriously on the subjects I have dwelt upon, and if any words of mine shall have been of practical use or good to those who have patiently followed me in my arguments and remarks, or shall have influenced you, by all the means in your power, manfully to set your faces against all pretensions, shams, and conceits, which are the curse of good art of every kind.

The art of our houses should speak the language of our own day, and not be a reproduction or imitation of the art, no matter how beautiful, of other days, in which the conditions of life were totally different; but even as by study of all that is purest and best in past literature, we learn to speak and write well our own language and thoughts, so assuredly should we study the art-work of past ages, not as work to be cruelly travestied or slavishly copied in our own day, but as a means of imbuing us with a knowledge of all that is graceful and beautiful in art, whether in architecture, painting, or sculpture, or those offshoots which are called "industrial arts." To some few of us, the sense of correctness of form, and truth, and harmony of outline or colouring, comes naturally, as the musical words and rhythms flow from the brain of the poet, but with most of us, this can only be attained by serious study and observation; and hence, to a great extent, from this want of knowledge in ourselves, we are content to accept the interested babble of false teachers as the truthful outcome of that knowledge, which we ourselves do not possess. Let us, then, by all means in our power, seek to foster and encourage a better taste, and a more truthful treatment in the art work of our homes, to avoid shams and pretentious conceits, seeking rather for things substantial, useful, and refined than for those splendid and luxurious; and for simplicity, comfort, and suitability, rather than pretentiousness, show, and elaboration in everything about us; so that, with better and more educated taste, combined with truth and beauty of design and construction of the works we have around us, we may live in a more healthy atmosphere of art in domestic life; and by the influence exercised by the demand created for higher artistic excellence in all trades cognate to art, be able to surround ourselves in our homes with the grace and preciousness of beauty and refinement.

MISCELLANEOUS.

DR. HULLAH'S SUGGESTIONS ON TRAINING TEACHERS.

Memorandum Addressed to H.R.H. the President of, and the Noblemen and Gentlemen composing, the Committee of the New Royal College of Music at South Kensington.

Extracted from Dr. John Hullah's Report on Musical Instruction, &c., to the Lords of the Committee of Council on Education.

Considerable indifference to the condition of musical instruction in elementary schools prevails generally among musicians of the higher order throughout Europe. It is very desirable that this indifference be removed, at least among ourselves, for an increase of musical skill among the people would certainly bring with it an increase in the number of readers of good musical works, and of hearers of good musical perform-

ances, alike to the advantage of the people, the art itself, and its professors.

The first step towards the removal of this indifference would seem to be the giving to such professors interests and occupation in the carrying out of such instructions, (1) by bringing teachers in elementary schools more directly under their influence, and (2) by placing under their direction the inspection of the musical work done in such elementary schools.

The Royal College of Music, at present in contemplation, presents a field wherein both these means might be applied.

There are now in England, Wales, and Scotland, fifty-one training schools for schoolmasters and schoolmistresses, in all of which vocal music, and in some, instrumental, is taught. I propose:—

(1.) That from these training schools a selection of a limited number be made annually of those students who, at the end of their two years' training, show the most skill in, and aptitude for, music, and that these be placed in the Royal College, during a period not exceeding 12 (?) months, for the purpose of carrying further their musical studies, in classes expressly arranged for them, and otherwise participating in its advantages. These students would, at the close of their residence, receive testimonials of their qualifications as musical instructors, and should then be placed in large towns or other centres in which they might teach in the upper classes of elementary schools, and aid and direct the teaching in the lower.

(2.) That annual inspections of schools so taught be made by or under the directions of the professors of the Royal College, and that the annual grant for efficiency in music now made by the Education Department be in future awarded to each school on the report of such professor. (Signed) John Hullah.

London, August 20, 1879.

MINING EXPLOSIVES.

The joint Committee of the Royal Cornwall Polytechnic Society, the Miners' Association of Cornwall and Devon, and the Mining Institute of Cornwall, appointed to inquire into the nature, economy, efficiency, and safety of the various explosives in use, or proposed for use, in the mines of Cornwall and Devon (see *Journal*, vol. xxviii., p. 18) have issued their report. They regret that they have been unable to carry out so extended a series of experiments as they would have wished, owing the limited response to their appeal for funds from those specially interested.

The following explosives were dealt with:—1. Gunpowder of five different grades. 2. Espir's explosive powder, a mixture of nitrate of soda 60, sulphur 14, sawdust 26 per cent. 3. Gun-cotton. 4. Tonite, said to be gun-cotton combined with nitrate of baryta. 5. Titanite. 6. Dynamite, two varieties; nitro-glycerine 75 and kieselguhr (or infusorial earth consisting of the siliceous skeletons of microscopic organisms) 25 per cent. The second variety contained less nitro-glycerine and some charcoal and nitrates. 7. Blasting gelatine, collodion cotton seven to ten parts combined with 90 to 93 of pure nitro-glycerine, nearly all the cotton being soluble in alcohol. 8. Liverpool cotton powder, a mixture of gun-cotton and nitrate of potash. The first trials were in an open quarry (Seveock, near Chacewater), a number of holes having been drilled to give as far as possible similar conditions. Each competitor had three holes, and the value of work done was estimated from the cost of powder as a standard. Seven different kinds of explosives were used, including three varieties of powder—common, compressed, and specially strong. The results showed that, assuming the work done to be approximately proportionate to the depths of the holes, that common powder was the cheapest—$\frac{3}{4}$d. per foot of hole—and dynamite the most costly—$3\frac{1}{4}$d. per foot. The second series of experiments consisted in driving levels not less than 7 ft. high and $4\frac{1}{2}$ ft. wide. Six kinds of explosives were tried, dynamite, Espir's, Liverpool common powder, compressed, and common powders, and tonite. Here the compressed powder took the lead, the total cost per foot run of level having been 5s. $1\frac{1}{2}$d. (1s. 1d. for materials and 4s. $0\frac{1}{2}$d. for labour); the dynamite came out fourth, and the tonite was most expensive. A list of questions referring to the relative advantages and disadvantages of the various explosives was sent out to about 250 persons interested in the subject, and 35 replies only were received, some of which were very brief. In wet grounds dynamite was almost unanimously declared to be the best, and a majority declared for the same explosive under most circumstances, except very dry ground, where powder was preferred. Nearly all agreed that the fumes from dynamite are the most dangerous, and a considerable weight of opinion intimated that powder was less dangerous to deal with than any other explosive. One authority stated that there was always danger in using dynamite in fissured ground, as unburnt portions of the charge were blown into the fissures, and exploded unexpectedly afterwards by the workmen.

ELECTRIC RAILWAYS.

The utility of the electric engine is about to be brought to a test in the United States. Eight miles of the iron road are set apart on the Camden and Amboy Railway, New Jersey, for the purpose of making an experiment. Two locomotives are in course of construction, which, with stationary engines at the terminal points, are expected to be in working order early in the month of September. If the trials be made to yield satisfactory results, it is in contemplation to apply the electric system to the Elevated Railway which, running through the streets of New York, causes, in its present state, a vast deal of annoyance and great inconvenience by reason of smoky locomotives, gaseous exhalations, and an intolerable rumbling noise. The electric engines are calculated to minimise these complaints; they will prove less noisy, emit no smoke or steam, nor fill the air with cinders. In addition thereto, they will introduce great economy in the working expenses of railways.

The electricity which supplies the motive power is generated at stationary engines, and thence transmitted to the electric motor placed on the line, which in turn gives motion to the wheels, a copper wire of the thickness of three-quarters of an inch answering every purpose. The motor is very nearly the same as the one in use for the electric light, and the power so mysteriously created is communicated to the wheels by means of leather bands. The motive power may be detached at will, a powerful brake works in connection with it, and the train comes to a standstill without any apparent effort.

It has been estimated that the city of New York would require no more than six electric stations for the use of the four railways which comprise the system of the city traffic. There is no immediate necessity to place the electric stations in close proximity of the railway track. The benefit arising therefrom is important, inasmuch as it admits the selection of a locality where facilities can be secured for an economical supply of water. Each of the six stations will be required to furnish its quota of power, each quota to be graduated according to the requirements of the traffic. The stationary engines are to be worked on an extremely economical plan. An inferior class of coals, compared with that required for locomotives, would answer the purpose, and, as regards weight, the actual consumption will show an enormous saving. Engineers and firemen, as now employed on locomotives, may be dispensed with. For the electric engine one man only is required, and the person in charge need not of necessity be a skilled labourer, the work demanding no more than ordinary intelligence.

As an illustration of the saving to be effected, it is reported that the New York Elevated Railway is working daily 160 locomotives of 30-horse power each. Assuming that it takes 10 lbs. of coals per hour to produce one-horse power, it follows that the outlay for coals aggregates 35,000 dols. monthly. This estimate assumes the price of coals to be at the rate of 4½ dols. per ton. The monthly salaries paid to engineers and firemen are computed at 25,000 dols. and 15,000 dols. respectively. The expenditure, therefore, of working locomotives represents a monthly total, in round figures, of 75,000 dols. Now, the six stationary engines would consume only about 100 tons of coals daily, or, say, 3,000 tons per month, involving an expenditure of 12,600 dols. The item might even be further reduced, inasmuch as an inferior quality of coals could be used. The emoluments to engineers and firemen at six stations would absorb about 3,000 dols., while that of the staff of electricians on the locomotives is computed at 15,000 dols. per month. This gives an aggregate total of 30,600 dols. against 75,000 dols. expended under the present system, as above estimated. The saving, therefore, would be equal to a sum of 44,400 dols. per month, or, say, about half a million dollars per annum.

The electric engine, it is stated, can be constructed at a cost of about 3,000 dols. (£600), which is equal to one-third only of the outlay at present incurred for steam locomotives. The weight of the electric engine is less than one-half of that of an ordinary locomotive, and the advantages accruing therefrom are that the noise is considerably lessened, and that the wear and tear of the line is reduced. While these items invite the attention of those interested in the management of railways, the chief factor, so far as the interest of the public is concerned, is that the electric engine ensures a large degree of safety; no smoke, cinders, or objectionable smells can possibly annoy the passenger. There is an entire absence of risk from fire, and as the brakes under the electric system can be worked with greater precision, the guarantee against accidents is very much augmented. Again, the current strength can be regulated at the electric stations, so as to prevent a train from travelling to a greater rate of speed than required.—*Times.*

POSTAL CONGRESS AT PARIS.

Committees of this Society have long tried to direct attention to the working of the parcel-post systems of Switzerland, Belgium, and Germany; and it is to be hoped that special attention will now be given to them, with other improvements, at the Congress referred to in the annexed most useful article from the *Daily News*. The enlargement of the parcel-post, and the utilisation of our thirteen thousand post-offices for the reception and delivery of parcels, as is done in those States, would, at this period of depression, give a great stimulus to trade. I know from communication with my lamented friend, Sir Rowland Hill, that he had that object much at heart. The obstructives were the railway directorates in Parliament, some of whom stated that they lost largely by the book-post. They have really gained by it, and would, under a proper administration, gain more than is gained on the Continent by the enlarged parcels-post. They declared, in a deputation to the Government, that the imposition of the rates for Parliamentary trains would be the ruin of their undertakings. In one discussion on railway reform, the chief of the Midland declared that third-class fares must be of inferior account. They are now the chief and largely-increasing source of their revenue, and so the directors of the telegraph companies declared their conviction that our first step in a postal telegraph at a uniform shilling rate would not yield a material increase on their numbers of messages. They have increased fourfold, and are advancing to fivefold. It was put forth that the applications of art and science to the improvement of telegraphic communication would be stayed by the change, for Government does everything badly as compared with them. It has gone on as it never did and never could have gone on before. The directorates of the London gas companies declared to the Government that the inforced reduction of their charges from 12s. to 4s. per 1,000 cubic feet of gas would be their absolute ruin. They are now obtaining maximum dividends, some of them at much lower rates than that. The Postmaster-General, who is a professor of political economy, will, it is to be hoped, be enabled to give practical lessons, on increasing ratios of consumption, from diminished ratios of charge. The chief obstructives to postal reform are not to be found in the postal department, but in the treasury, *i.e.*, those gentlemen who have gone on charging extensions to revenue, which ought to have gone to capital; if this had been done in railway directors' administration, there would scarcely have been a dividend-paying railway in the whole country. Think of the whole cost of the Manchester Post-office being charged to the year's revenue. I consider that we have been in default in one point, in the due appreciation of the oil that makes administrative wheels work smooth, and in not urging that the officials of the Postal department should receive extra pay for all extensions of their service; and should have a good interest in the results of every improvement.

Edwin Chadwick.

"The telegraph arrangements of our own country might equally, at such a Postal Congress as is now being held, be made the subject of comparison, and perhaps of improvement. Our rates are indeed uniform, but uniformity has been attained by fixing a necessarily high unit. In France the rate is a halfpenny a word, with a minimum charge of half a franc. In Switzerland there is a fixed tax for the telegram, and then a charge of a farthing a word; in Italy short messages are sent from one part of the same town to another for half a franc. In Germany and Austria the telegram tax is about threepence, and each word in the message costs a halfpenny. On the whole, perhaps, our own system has much to recommend it, but as to one incident of our telegraphic system, and the necessity for its alteration, there can, however, be no question. It is simply a monstrous thing that a telegram sent from Paris to London should cost four francs, while the same message sent from Paris to Dover or Croydon should cost six. The principle at once of uniformity and of common sense is discarded when such a regulation is enforced. Even if the message had, through some piece of blundering officialism, to come first to London and then to be re-dispatched, the amount of the additional fee would not be explained. The same rule holds good in the intercommunication of other countries with the capital and the provinces, and telegrams from Switzerland and Italy are equally subject to an extra tax when the English destination is not London. The main purpose of the Congress in Paris, however, is practically to extend all over the world a department of post-office management which has worked for years successfully in Germany. The German Post-office will charge itself with the conveyance of small parcels very much bulkier than those which we are allowed to send through our book post, but still smaller than what would come under the rank of luggage, at rates which are reasonable and computed on an intelligible scheme. If this could be extended to England and to the other countries of the Postal Union it is clear that commerce generally would receive an impetus from the increased facilities for its exercise. But it is said there are difficulties which perhaps may not be at present surmounted. In any case the Congress will have served a useful purpose if it introduces to the notice of the delegates of the different countries the minor advantages which each has worked out in the administration of its own department."

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

BARRY'S PICTURES.

The series of pictures painted for the Great Room of the Society by James Barry, R.A., have been cleaned during the recess, and a private view was held on Monday, October 25th, from two to five p.m., when certain of the members, artists, and others were present.

A pamphlet, containing a description of the pictures, and an account of the proceedings of the Society in connection with their production, has been prepared by the Secretary, and can be obtained by any member on application.

Any person desiring to see the pictures can do so on presentation of a visiting card.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council are Trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "Students of the Schools of Art who in annual competition produce the best Designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones;" the prizes to "consist of a bound copy of Owen Jones's 'Principles of Design,' a Bronze Medal, and such sums of money as the fund admits of."

The prizes will be awarded on the results of the Annual Competition of the Science and Art Department. Competing designs must be marked "In competition for the Owen Jones Prizes."

The next award will be made in 1881, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

ARRANGEMENTS FOR THE SESSION.

The arrangements for the one hundred and twenty-seventh session of the Society have now been made by the Council, and full particulars will be printed in the next number of the *Journal*.

The first meeting will be held on the 17th November, when the opening address will be delivered by F. J. Bramwell, F.R.S., Chairman of the Council. Previous to Christmas, there will be four ordinary meetings in addition to the opening meeting. On the 24th November, a Paper will be read by Mr. J. Comyns Carr, on "The Influence of Barry upon English Art." Candidates proposed for election as members, are privileged to attend the opening meeting.

There will be five courses of Cantor Lectures during the session. The first course, on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Professor A. C. Church, will be delivered before Christmas.

The two Juvenile Lectures at Christmas will be by G. J. Romanes, F.R.S., on "Animal Intelligence." Announcement of the arrangements for these Lectures will be made in due course.

THE CHEMICAL COMPOSITION OF BOILER INCRUSTATIONS, WITH THE ANALYSES OF THE WATERS USED FOR STEAM PURPOSES, AND OF THE MATERIALS WHICH ARE EMPLOYED AS ANTI-INCRUSTATORS.

By W. Ivison Macadam, F.C.S., F.I.C.

Lecturer on Chemistry and Analytical Chemist, Edinburgh.

For the last three years I have been engaged in an investigation as to the chemical composition of boiler incrustations, as also of the composition of the waters used for steam purposes, and of the materials employed as anti-incrustators.

The subject is one of much importance to steam users, and although, from time to time, various analyses and reports on the composition of boiler incrustations have been read before the learned societies, yet I am not aware that any attempt has, before this, been made to give a series of such an extent as to warrant the drawing of conclusions of any practical use and certainty.

During the course of this inquiry some hundreds of analyses have been made, and the samples, although mostly of Scotch origin, have a few English specimens in the number.

In treating the subject, I propose, first, to deal with the incrustations themselves, then with the feed waters, and afterwards to consider the various classes of anti-incrustators, and the action of such when in use. The analyses quoted have been carefully made, and the figures verified by repetition, whilst only representative results are placed under each head.

Incrustations.

When water is brought to the boiling point, either with or without other than atmospheric pressure, and maintained at that temperature, it tends more or less quickly to deposit the saline matters it contains in solution. These saline deposits are of two classes. The first series contain all those incrustations which are composed of substances insoluble in water, but soluble in an excess of carbonic anhydride (carbonic acid gas). This class consists principally of carbonates, those of lime and magnesia being the most common. The second series contain much sulphate of lime, which is present in a soluble condition in the feed water.

Carbonate Class.—Waters commence depositing carbonates immediately on being heated, and continue doing so as long as there is any free carbonic acid gas contained in the water. The incrustations of this class are hard, firm cakes, which are difficult to remove from the boiler, and usually require to be chipped off with a hammer and chisel. The following analyses will show the chemical composition, the results being calculated to per-centages:—

Boiler Incrustations.

Carbonate Class (no anti-incrustator used).

	District from which Sample was Obtained.				
	No. 1. Dunbar.	No. 2. Selkirk.	No. 3. Slough.	No. 4. Edinburgh.	No. 5. Carlisle.
Ferric Oxide (Fe_2O_3) Aluminic Oxide (Al_2O_3), &c.	7·46	2·96	2·36	2·48	2·96
Calcic Carbonate ($CaCO_3$)	32·16	74·25	50·04	62·95	75·92
Calcic Sulphate ($CaSO_4$)	5·64	3·08	29·76	20·80	3·16
Magnesic Carbonate ($MgCO_3$)	20·04	3·76	10·84	7·24	10·16
Sodic Salts, &c.	3·31	1·15	0·86	0·86	0·84
Silica (SiO_2)	16·94	8·56	4·28	3·76	4·94
Organic Matters	7·70	3·02	0·48	0.12	0·22
Moisture	6·78	3·10	1·22	1·22	1·53
Total	100·05	99·88	99·84	99·43	99·73
Source of Water Supply	Well.	River.	Spring.	Well and Town Supply.	River.

From the above analyses, it will be seen that the principal ingredient is calcic carbonate, whilst carbonate of magnesia and sulphate of lime are present in smaller proportions. The iron oxide is also small in amount, showing little corroding action on the boiler plates.

Sulphate Class.—The incrustations belonging to this series contain, as their characteristic element, sulphate of lime. The waters which contain this salt do not, when first heated, deposit, but as they become more and more concentrated by the volatilisation of the steam, the water becomes unable to retain the saline matters in solution, and they are, therefore, gradually deposited. The series form tough, hard cakes, which are with difficulty removed from the boilers. The following analyses will show the composition calculated to per-centages:—

Boiler Incrustations.

Sulphate Class (no anti-incrustator used).

	District from which Sample was Obtained.						
	No. 6. Prestonpans.	No. 7. Granton.	No. 8. Granton.	No. 9. Whitehill.	No. 10. Slough.	No. 11. Smeaton.	No. 12. Carlisle.
Ferric Oxide (Fe_2O_3) Aluminic Oxide (Al_2O_3)	4·64	3·56	2·88	2·92	5·04	1·68	4·06
Calcic Carbonate ($CaCO_3$)	1·22	26·56	17·31	16·45	25·62	9·72	1·21
Magnesic Carbonate ($MgCO_3$)	10·36	23·16	18·04	17·32	5·56	18·40	5·60
Calcic Sulphate ($CaSO_4$)	78·32	38·16	53·76	39·28	55·92	56·28	50·36
Sodic Salts, &c.	0·64	1·75	0·54	0·86	0·22	0·56	0·21
Silica (SiO_2)	3·22	5·42	4·36	21·62	5·26	9·46	36·22
Organic Matters	0·56	0·12	0·33	0·17	0·36	2·64	0·68
Moisture	0·72	1·04	0·78	1·18	1·34	1·67	1·88
Total	99·68	99·77	100·02	99·80	100·30	100·41	100·22
Source of Water Supply	Pits and Surface Water.	Quarry and Salt Water.	Quarry	Pits and Surface Water.	Well.	Burn.	....

The above results show that the substance which is present in greatest amount is the calcic sulphate, and that calcic carbonate, magnesic carbonate, and iron oxide, are found in less proportions.

Waters.

The waters most usually employed in the steam boilers throughout the country are hard in quality. This probably arises from the fact that boilers are generally to be found in towns and populous places which have introduced a water supply from a distance. This supply is not, as a rule, so abundant as to admit of its being used for other than domestic purposes; and even where an unlimited supply is at hand, the cost is such as to debar its general adoption. Manufacturers are, therefore, compelled to go to other sources for their supplies, and recourse is had to wells. These wells are generally hard in nature, and are of two distinct classes, (1) those which contain carbonates, and are termed temporary hard waters, and (2) those having sulphates in solution, and forming what are called permanently hard waters. It is not uncommon to employ dirty or sewage waters, and also pit waters. The latter class of waters often contain much iron and alumina as acid sulphates, and are most injurious to boilers; for, besides forming hard incrustations, they act upon the iron of the boiler plates, gradually eating them through. Sewage waters are much esteemed by practical engineers, as they are said to scour or clean the boilers, a property which is due to the oily matters they hold in suspension, and the presence of which renders their use inadvisable. Much will also be effected by the organic substances in solution and suspension, which, mixing with the deposit as it is precipitated, do not permit of the formation of a hard scale. They give generally a soft mass or powder, which is readily removed from the boiler.

The following are analyses of those various classes of water, the results being calculated in grains per imperial gallon:—

Steam Boiler Soft Waters.

Grains In One Imperial Gallon.	District from which Sample was Obtained.			
	No. 13. Selkirk.	No. 14. Glasgow.	No. 15. Fountainhall.	No. 16. Carlisle.
Total Saline Matter	2·56	1·28	4·72	9·92
Total Organic Matter	0·68	0·36	1·16	4·46
Total Solid Matter	3·24	1·64	5·88	14·38
Chlorine	0·50	0·25	0·25	0·75
Calcic Carbonate	0·98	0·36	1·46	4·06
Calcic Sulphate	0·22	0·22	0·43	0·36
Source of Supply	River.	Loch.	River.	River.

These results show the water to be of good quality for steam purposes.

Steam Boiler Hard Waters from Wells.

Grains In One Imperial Gallon.	District from which Sample was Obtained.					
	No. 17. Edinburgh.	No. 18. Dunbar.	No. 19. Craigleith.	No. 20. Edinburgh.	No. 21. Slough.	No. 22. Galashiels.
Total Saline Matter	15·68	64·00	58·24	25·60	24·96	10·24
Total Organic Matter	3·20	7·04	9·28	12·16	6·72	6·08
Total Solid Matter	18·88	71·04	67·52	37·76	31·68	16·32
Chlorine	2·5	24·8	7·0	3·75	2·75	1·7
Calcic Carbonate	13·18	21·04	43·66	14·36	7·14	2·44
Calcic Sulphate	1·03	19·21	8·24	7·12	9·23	6·31
Source of Supply	Town Supply, Rain Water, and Well.	Well.	Well.	Well, Canal, and Town Supply.	Well.	Well.

Steam Boiler Hard Waters from Pits.

Grains In One Imperial Gallon.	District from which Sample was Obtained.					
	No. 23. Whitehill.	No. 24. Granton.	No. 25. Whitehill.	No. 26. Gorton.	No. 27. Carberry.	No. 28. Smeaton.
Total Saline Matter	24·08	10·88	20·48	31·68	35·64	50·88
Total Organic Matter	2·88	6·08	3·20	4·28	11·20	9·28
Total Solid Matter	26·96	16·96	23·68	35·96	46·84	60·16
Chlorine	1·5	2·75	2·0	1·3	2·0	2·0
Calcic Carbonate	18·21	3·42	8·43	12·26	18·56	12·27
Calcic Sulphate	4·31	4·06	6·54	14·33	12·21	20·54
Source of Supply	Pits.	Quarry.	Pits.	Pits and Surface.	Pits.	Pits and Burn.

Steam Boiler Waters.—Sewage Impregnated.

Grains In One Imperial Gallon.	District from which Sample was Obtained.		
	No. 29. Portobello.	No. 30. Edinburgh.	No. 31. Kinghorn.
Total Saline Matter	15·36	26·56	15·68
Total Organic Matter	6·40	6·72	6·40
Total Solid Matter	21·76	33·28	22·08
Chlorine	3·7	7·0	5·0
Calcic Carbonate	6·16	5·61	12·21
Calcic Sulphate	16·00	16·32	0·34
Source of Supply	Burn.	Burn.	Loch.

Anti-Incrustators.

All waters, whether hard or soft, when employed for steam purposes, give a deposit or incrustation, which falls to the bottom, and adheres firmly to the boiler plates. These incrustations cause a very great loss of heat, amounting, in some cases, to nearly 35 per cent. of the fuel used, and when allowed to remain, soon make the plates of the boiler twisted and broken, besides very often being the cause of disastrous explosions and great loss of life and property. Many substances are used to prevent the incrusting of the plates of boilers, some of which profess to retain the salts in solution, whilst others act mechanically. As to the first of these classes, a material which can act on the hard firm incrustation, and render it soluble, will, most likely, also eat into the boiler, and thus cause more damage than good, and, even if successful, would lead to priming. The second series, however, play an important part. Their object is to compel the sediment of the water to be given off in such a state that it shall not adhere to the bottom or sides of the boiler or tubes. This is a very large class, and contains many members widely differing from each other in chemical composition and characters. For convenience of consideration, they can be divided into (1) saline, (2) fatty, (3) organic and gelatinous, and (4) paraffin and paraffin products.

Boiler Incrustations.—Carbonate of Soda Employed.

	District from which Sample was Obtained.		
	No. 32. Galashiels.	No. 33. Edinburgh.	No. 34. Edinburgh.
Ferric Oxide (Fe_2O_3) .... } Aluminic Oxide (Al_2O_3) .. }	1·96	9·84	3·44
Calcic Carbonate ($CaCO_3$) ..	34·67	63·64	9·52
Magnetic Carbonate ($MgCO_3$)	23·84	5·32	19·88
Calcic Sulphate ($CaSO_4$)	25.88	1·44	48·20
Sodic Sulphate (Na_2SO_4)....	6·41	4·45	10·02
Silica (SiO_2)	5·54	10·34	5·36
Organic Matters	0·25	1·09	0·32
Moisture	1·34	2·53	3·06
Total	99·89	99·65	99·80
Source of Water Supply	Well.	{ Water Supply. }	Well.

Saline Compositions.—The more commonly met with saline materials used as anti-incrustators are washing soda and soda ash. When these bodies are added to a water, the lime salts present in it are precipitated at once as carbonates, and form a dense white flocculent mass. The water, on boiling for some time, deposits a hard cake of incrustation which it is difficult to remove. The compositions consisting of carbonate of soda are many in number, and have special names according to the fancy of the vendor. One sample analysed was coloured with blue litmus. The foregoing analyses are from incrustations where carbonate of soda is employed.

These results show a large amount of sulphate of soda, which has been formed by the carbonate of soda and the sulphates of the water interchanging acids, and becoming sulphate of soda and carbonate of lime.

Fatty Compositions.—In this series are included tallow and the fatty oils. The employment of tallow, although common, is attended with much danger, as is proved by the number of boiler explosions from this cause, the boilers showing, when examined, that quantities of the tallow have combined with the lime salts, to form an insoluble lime soap, which, adheres to the plates of the bottom and sides of the boilers, allowing the iron to be overheated, and causing the plate to be burned and twisted. Besides this, fatty acids are evolved, which attack the iron plates and gradually eat them through. This is readily observed from the analyses of incrustations of this class, which show a considerable proportion of iron:—

Boiler Incrustations—Tallow Employed.

	District from which Samples were obtained.	
	No. 35. Glasgow.	No. 36. Fountainhall.
Ferric Oxide (Fe_2O_3..... } Aluminic Oxide (Al_2O_3) .. }	11·60	25·72
Calcic Carbonate ($CaCO_3$) ..	5·92	44·83
Magnesic Carbonate ($MgCO_3$)	6·76	6·44
Calcic Sulphate ($CaSO_4$)	1·52	3·12
Sodic Salts, &c.	trace	0·44
Silica (SiO_2)	12·16	13·33
*Organic Matters	58·50	3·80
Moisture	3·64	2·24
Total.....	100·10	99·92
Source of Water Supply	Loch.	River.
*Oily Matters	57·47	3·20

The employment of waste or condensed steam often leads to the introduction of tallow into boilers. The following analysis of a sediment from a condensed steam tank, shows the action of the tallow on brass or copper, and iron, as well as the amount of oily matters carried over by steam:—

Sediment from Condensed Steam Tank.

(District from which Sample was taken—No. 37, Sheffield.)

Ferric Oxide (Fe_2O_3)	50·21
Aluminic Oxide (Al_2O_3)	1·07
Calcic Carbonate ($CaCO_3$).....	0·31
Magnesic Carbonate ($MgCO_3$).....	1·28
Calcic Sulphate ($CaSO_4$)	1·43
Cupric Oxide (CuO)	0·88
Sodic Salts, &c.	0·11
Silica (SiO_2)	1·38
*Organic Matters	41·93
Moisture	0·87
Total.....	100·47
*Oily Matter	41·36

Organic and Gelatinous Compositions.—Some waste materials from manufactories are employed as anti-incrustators. Peat or moss is used in some works where it can readily be obtained, and is of considerable service. It evidently acts, as do all the members of this class, by keeping the deposit from the water in continual motion, and the particles mixing with the solid, retard the formation of a firm deposit. They yield a soft mass or powder readily removed from the boiler. The following analyses show the composition of deposits from boilers using this class of anti-incrustators:—

Boiler Incrustations.

Organic or Gelatinous Compositions Employed.

	District from which Sample was Obtained.								
	No. 38. Birmingham.	No. 39. Birmingham.	No. 40. Carberry.	No. 41. Alloa.	No. 42. Newbattle.	No. 43. Whitehill.	No. 44. Whitehill.	No. 45. Whitehill.	No. 46. Gorton.
Ferric Oxide (Fe_2O_3) } Aluminic Oxide (Al_2O_3) }	2·20	2·60	2·34	3·08	14·00	5·16	1·68	2·16	2·48
Calcic Carbonate ($CaCO_3$)	29·28	10·18	16·54	44·32	19·84	16·00	29·69	39·27	32·19
Magnesic Carbonate ($MgCO_3$)	6·11	7·46	22·84	20·76	16·44	25·60	37·32	10·44	9·06
Calcic Sulphate ($CaSO_4$)	53·53	71·35	28·08	11·16	30·03	18·28	22·32	31·68	42·88
Sodic Salts, &c.	0·54	0·32	1·23	0·41	0·36	0·92	1·31	1·06	1·56
Silica (SiO_2)	2·29	2·22	8·12	14·46	12·22	19·43	3·84	10·36	8·96
Organic Matters	3·37	4·14	14·04	2·26	5·13	11·13	2·65	1·18	1·54
Moisture	2·32	1·74	6·58	3·53	1·74	3·42	0·98	3·18	0·97
Total	99·64	100·01	100·07	99·98	99·76	99·94	99·79	99·53	99·64
Source of Water Supply	..	..	Pits.	Well.	Pits.	Pits.	Pits.	Pits.	Pits and Surface Water.

It will be observed that these analyses agree very nearly with those obtained from boilers using no anti-incrustator. The organic matter is in some of the cases higher, but the greatest difference is, that, whilst the one is a hard scale very difficult to remove, the other is a soft mass readily cleaned away.

There is a class of anti-incrustators employed which contain a gelatinous body with a saline substance (generally washing soda). Such materials throw down the lime salts, and by their mechanical action tend to yield an incrustation not nearly so hard as the plain salts do. The following table shows the results of the analyses of incrustations from boilers employing this large class of mixtures:—

Boiler Incrustations.

Mixed Gelatinous and Saline Compositions Employed.

	District from which Sample was Obtained.											
	No. 47. Craigleith.	No. 48. Linlithgow.	No. 49. Leith.	No. 50. Leith.	No. 51. Edinburgh.	No. 52. Portobello.	No. 53. Edinburgh.	No. 54. Edinburgh.	No. 55. Kinghorn.	No. 56. Edinburgh.	No. 57. Portobello.	No. 58. Leith.
Ferric Oxide (Fe_2O_3) } Aluminic Oxide (Al_2O_3) }	5·36	2·12	4·16	1·96	3·84	3·68	3·72	15·44	4·16	4·72	12·84	5·20
Calcic Carbonate ($CaCO_3$)	71·67	8·68	15·17	11·36	8·28	47·35	58·78	25·32	60·85	69·55	63·05	27·06
Magnesic Carbonate ($MgCO_3$)	11·08	15·40	11·08	7·76	13·96	6·42	6·84	5·61	19·44	11·92	3·44	10·88
Calcic Sulphate ($CaSO_4$)	8·56	59·60	55·96	66·16	65·48	33·10	16·24	10·62	6·33	4·80	16·40	36·16
Sodic Sulphate, &c.	0·62	3·14	4·46	5·67	0·56	0·36	3·11	3·26	1·17	1·22	1·04	0·14
Silica	1·24	3·65	7·30	2·24	6·23	6·43	6·61	13·78	5·56	5·24	6·36	15·88
Organic Matters	0·86	0·86	2·23	2·37	0·86	0·58	1·60	21·33	0·26	0·31	0·44	2·06
Moisture	0·49	6·33	1·59	1·35	1·22	1·84	2·97	4·65	2·08	2·27	1·14	2·72
Total	99·88	99·78	99·95	99·87	100·43	99·76	99·97	100·11	99·88	100·03	99·71	100·10
Source of Water Supply	...	Spring, Surface, and Well.	Sewage and Surface.	Sewage and Surface.	Canal.	Sewage Burn.	Sewage.	Sewage.	Loch.	Canal.	Sewage Burn.	Sewage.

Paraffin and Paraffin Products.—The last class of anti-incrustators are paraffin and paraffin products. Paraffin itself is employed in considerable quantity, and gives good results. It acts entirely by coating the particles of sediment, forming them into minute balls or pellets, which do not adhere to each other, and these being constantly kept in motion, yield a light granular sediment readily removed from the boiler. The amount used is about one pint per week. The results of the analyses of sediments from such boilers are as below:—

Boiler Incrustations.—Paraffin Oil Employed.

	District from which Sample was obtained.		
	No. 59. Galashiels.	No. 60. Galashiels.	No. 61. Dunse.
Ferric Oxide (Fe_2O_3) ..... } Aluminic Oxide (Al_2O_3) ..... }	5·48	2·12	22·88
Calcic Carbonate ($CaCO_3$)	34·03	53·16	1·21
Magnesic Carbonate ($MgCO_3$) ..	29·16	20·03	3·08
Calcic Sulphate ($CaSO_4$)	4·04	15·52	60·88
Sodic Salts, &c.	0·26	0·56	0·36
Silica (SiO_2)	13·88	5·56	10·66
Organic Matters	6·61	0·44	0·24
Moisture	5·48	2·03	0·58
Total	98·94	99·92	99·89
Source of Water Supply	Well.	Well.	Well.

Sample No. 61, from Dunse, had tallow introduced along with the paraffin oil, and it is due to this that the iron oxide is so large in quantity. Paraffin oil, when introduced into a dirty boiler, soaks into the incrustation, and gradually causes the hard sediment to crack and split up, when it is easily removed. On account of its mode of action being to prevent the incrustation thickening, it is found better to coat the inside of the boiler when empty with the paraffin. The employment of condensed water should be dispensed with on account of the large amount of fatty oils it contains. The use of paraffin oil is unattended with the constant priming which is found to take place when tallow is employed, and the amount of oil introduced can be increased without running any risk or delay from this cause. Paraffin mixed with fatty oils composes several well-known compositions. The substance does not mix well, and floats on the surface of the water in the boiler.

The soda liquor obtained as a waste substance during the purification of paraffin oil is largely employed, and furnishes some of the more commonly used compositions. The incrustations from boilers using this soda liquor give the results, on analysis, stated in the table in the next column.

Zinc has lately been used to a considerable extent, and seems to work well in marine boilers. The action is said to be galvanic. It has been tried several times in land boilers, but, so far as I can learn, has never been successful, and, in fact, the incrustation was deposited as fast as when no anti-incrustator is employed. These experiments go far to prove that the action is not caused by galvanism, but to some definite chemical action probably due to the chlorides of the sea water.

Looking to the fact that most steam raising water is hard, and considering the loss of time and money consequent on the laying up of the boilers for cleaning, it comes to be an important point as to whether it would not be advisable to soften the water before use. This is easily accomplished, for provided the water be

Boiler Incrustations.—Paraffin Soda Liquor Employed.

	District from which Sample was obtained.	
	No. 62. Leith.	No. 63. Edinburgh.
Ferric Oxide (Fe_2O_3) ..... } Aluminic Oxide (Al_2O_3) ..... }	3·52	2·12
Calcic Carbonate ($CaCO_3$)	1·04	84·86
Magnesic Carbonate ($MgCO_3$)....	7·96	1·76
Calcic Sulphate ($CaSO_4$)	60·12	3·52
Sodic Salts, &c.	1·41	1·37
Silica (SiO_2)	15·53	3·02
Organic Matters.....	4·39	1·26
Moisture	5·82	1·96
Total.....	99·79	99·97
Source of Water Supply	Sewage and Surface.	Town Supply, Rain Water, and Well.

"temporary" hard (that is, contains carbonate of lime), the use of Clark's process will soften it. The process consists in adding lime to the water, which combines with the free carbonic acid gas, forming insoluble carbonate of lime, which falls to the bottom of the vessel, accompanied by all the carbonate of lime previously held in solution by the free carbonic acid gas. When the water contains sulphate of lime, and is "permanently" hard, the addition of a small quantity of washing soda will remove the greater part of the lime salts, and render the water soft. The softening process should be employed before the water reaches the boiler, and will be greatly aided by heat from the waste steam, care being taken that a paraffin lubricant is employed for the cylinders. The softening of water has not been much practised, but much can be done in this way to improve boiler feed waters.

NEEDLEWORK.

Extracts from the Reports of Her Majesty's Inspectors of Schools for the Year 1879, showing the Progress made in Instruction in Needlework.

"If all the schools had been obliged to take up needlework as they are obliged to take up arithmetic, I feel no doubt the per-centage of success would have been very much higher.—Mr. Capel, Inspector, Warwick and Coventry Districts, p. 235.

"As to needlework, those schools in which it was already well-taught were not few, and the new requirements of the Code have affected them but little. Those schools in which the subject received less attention can hardly yet show the full result of such effort as some of them have made to conform to your Lordships' standard. I am afraid I am not one of those who expect marked improvement from the present mode of dealing with this subject. I quite think that, even amidst the interest and hurry of more congenial work, her Majesty's Inspectors may obtain sufficient knowledge and sufficient familiarity with certain merits and defects to constitute them tolerable judges of the general care and success with which the subject is taught. But I am sceptical as to our acquiring such practical knowledge or such acquaintance with technical

language as will ever make us very helpful advisers and directors, or enable us to hold our own against ladies of even fair knowledge of the subject, upon the niceties of an art we have never practised, as applied to garments we have never worn. Our opinion will be listened to as a lay opinion on any other subject is listened to by professors, but it cannot carry as much weight as the opinion of any lady, herself a practised needlewoman. I should be glad to see needlework made a subject of special annual report by some resident lady appointed, say in each union, or to inspect and direct the work of some 20 or 25 adjacent schools. Such a person could give practical advice and assistance, and having only a small number of inlying schools to visit, could really give the requisite time to each school, and could report with the authority and confidence that come of practical knowledge and detailed investigation. There must be many ladies highly competent for such a post, and the slight additional expense involved to the Department would be well repaid by the certain improvement that would result in an important subject."—Mr. Colvill, Inspector, Shrewsbury District of Shropshire, pp. 241-2.

"I should like also to see the rule now in force about domestic economy applied to needlework, so that if girls were presented for grant at all under Art. 19 C. they must take needlework. Another condition attached to this grant ought to be that the sewing mistress should be able to satisfy a competent board of examiners (not merely the inspector) that she thoroughly understood the cutting out, fixing, and making of such garments as would be made in her school, and that by work done in the presence of the examiners. She should then receive a special certificate as a sewing mistress. I am sure that many female teachers well trained in other ways are not competent to teach sewing, and do not know how to produce good work. The finished specimens of work shown at inspection are of little or no value, as proving that the children who present them can do similar work by themselves. In fact, they can seldom do anything at all like it. The only importance of the finished articles is that they prove that a certain amount of material has been provided. The children often freely admit that much of the work which they exhibit has been done by their mothers, or sisters, or friends. Their show work may therefore be ignored in the same way that their exercise books are for examination purposes. In one respect, the more garments you require to see completed the worse it is for the instruction in needlework, because the time and attention of the teachers is wholly occupied in getting so much done, instead of in teaching the children how to help themselves with their needles. This should be the sole aim. Were it attained, we should not see so many schools in which a tidy child was very much the exception, and rags were the rule. Many mothers and wives are now unable either to do their own work or to pay for having it done, the cost of making a thing being often more than that of the material."—Mr. Currey, Inspector, Northampton District, p. 257.

"Thanks to the indefatigable efforts of my predecessors, and the energetic and hearty co-operation of the teachers, the needlework is, generally speaking, in a very satisfactory state, and in many cases excellent. No difficulty has arisen in carrying out the provisions of the scheme of needlework issued by your Lordships, except in the matter of the garments cut out by the girls themselves in Stage IV. and upwards, and this has been caused chiefly by the fact that many children bring their own work, and the parents, doubting their daughters' ability, frequently cut out the garments themselves. The look of pride with which girls assure me their work is entirely their own, ought to bring some compensation for a slight misfit. Under the supervision of a competent and careful teacher, I am certain that the number of pieces spoiled would be exceedingly small. The specimens worked on the day of inspection are almost invariably carried away from the school and intrusted to Mrs. Thorpe, my assistant's wife, for examination. For her valuable assistance, so freely and generously given, I am very greatly indebted, and I seldom pronounce an adverse verdict without her concurrence, thus obviating any objection that might arise as to a man's judgment in the matter of needlework."—Mr. Dibben, Inspector, Wakefield District, p. 276.

"The needlework scheme in Schedule III. has been very generally adopted, and is on the whole working well, and bearing good fruit. With some few exceptions we have not got beyond Stage IV., and a large proportion of the girls have been examined in the work of the lowest stages. But, considering how little attention has hitherto been paid to this subject in infants' schools, and that the scheme previously in force in the district did not extend to Standard I., there is no reason to be dissatisfied. After this year the grounding may be expected to be done in the infant department. Though the recommendation with regard to boys has only in one instance found favour, the performances of some of the infant girls have been surprisingly good."—Mr. Gleadowe, Inspector, Crewe District, p. 288.

"The results of examination, in schools where needlework has been taken as a 'class subject' for the first time, show, in most cases, that though formerly a few girls in the school were good needlewomen, yet the general proficiency was very moderate. In some of the schools under the Leyton Board, the needlework, according to my judgment, is excellent. Needlework should be compulsory amongst the class subjects in girls' schools, just as domestic economy is among the specific subjects."—Mr. Helps, Inspector, Chelmsford District, pp. 299, 300.

"In girls' schools needlework has steadily improved, and the female pupil-teachers are also much more expert needlewomen than they were a short time ago."—Mr. Legard, Inspector, Leeds District, p. 324.

"On needlework my words this year will be few. I am so far disappointed with the results of the Third Schedule. Why it should not work for good I can hardly tell, since the changes from my own scheme were really very few. But the fact is, that while there has certainly been more care shown in the work done during the year, the examination work has almost everywhere fallen off. I mean, not merely in average results—this might have been due to the introduction of Standard I—the higher work is also distinctly worse. I can only suppose that the new exercises have taken up so much time that the old have been more or less slighted. I hope it is the effect of a transition year, which will pass away. Some minor points of the schedule might be amended; but it is very important to have no fresh changes at present."—Mr. Moncreiff, Inspector, Bristol District, p. 337.

"The needlework is greatly improved, although unless done before the inspector there is no guarantee that it is done by the children. In this one subject I find that Cumberland is inferior to Northumberland. I should recommend that the needlework should always be done before the inspector; for the children have been known to leave school and go into service without being able to sew. This will, no doubt, give more trouble to the inspector, and the girls will, in winter, have to be examined before the boys, on account of the light. I think that pupil-teachers should also sew before the inspector; the marks now obtained by them in this district are very high. There has been some trouble as to the supply of material. I recommend that the

managers should supply it, and sell the garments to the parents at the cost of the material only. It is to be remembered that managers obtain a special grant for needlework done in this way, and are, therefore, in a better position to pay for the materials."—Mr. Pennethorne, Inspector, Northumberland District, p. 367.

"Needlework has improved considerably since it was made a class subject under Art. 19 C.: whether it will continue to improve under Schedule III. remains to be seen. But to have established a common standard throughout the country is, without doubt, in itself, an advantage. Into the details of Schedule III. I will not venture to enter here, but I may perhaps be allowed to hazard a regret that the standard classification has been deserted in that scheme. Doubtless a distinct organisation was adopted in the expectation that the numbers presented in the higher stages might be increased thereby; but the effect has been the precise contrary. From the 1st May (when the Schedule came into force) to July, 332 girls were examined in Standards IV., V., and VI., in schools which took up needlework as a class subject. Of these only 8 were presented in the sixth stage, 21 in the fifth, and 191 in the fourth. The remainder, one-third of the whole, were presented in stages lower than their standards. A child's class in the grammar, geography, and history examination is determined by its proficiency in the three R's, and rightly, since this system tends to encourage equable progress all round. Why should a different principle be applied in the case of sewing? But a graver objection to the present plan than any mere theoretical anomaly is the practical effect it has in taking the control of the grant for this subject entirely out of the inspector's hands. There is nothing to prevent the sewing mistress presenting the same girls over and over again in the same stage, or at least in stages much below those in which they ought to pass. True it is that one class must be presented as high as the fourth stage (to be raised hereafter), but this class may be just as large or just as small as the mistress pleases. Under these circumstances the degree of annual progress must become an unknown quantity for the inspector, and the grant an enervating certainty for the schools. In rural mixed schools, under a master instruction, needlework labours under some special disadvantages. One is the difficulty of obtaining an instructress possessing any idea of method or organisation. Another is the great affection happily entertained for knitting, and the great indifference unhappily felt for sewing, in the homes of our children. It results that, although in almost all parts of this district the children are already fairly proficient knitters when they come to school, they have to be taught sewing *ab initio*; and, moreover, their progress is checked by the anxiety their parents discover that they should spend their school-time in supplying themselves and their baby brothers with socks. Further, when they do bring sewing with them, it is of so heterogeneous and hap-hazard a description that systematic instruction is out of the question, and the school during the lesson is in danger of becoming a kind of domestic factory."—Mr. Tremenheere, Inspector, Kendal District, pp. 421-2.

"Needlework, for the same reason, I can but very briefly touch upon. Unquestionably this has immensely improved since it was made a class subject under Art. 19 C., but there is much room for improvement. I should hardly venture upon the statement if I had not the support of many ladies of experience, but there are many mistresses by no means competent to teach needlework in many of its branches. For example, I may mention the rubbish frequently given me as pleating; herringboning, too, is frequently so taught as to make it clear the teacher does not know its proper use. But the great fault is that children are not taught to apply the knowledge they acquire. Many a girl will pass successfully through all the stages of needlework, and be utterly valueless with her needle when she leaves school and takes a situation as under-nurse. I speak from experience."—Mr. Wilkinson, Inspector, Lichfield District, p. 453.

"The quality and quantity of the needlework vary in different parts of my district and are in inverse ratio to the circumstances of the parents. The infants' sewing is not so good as it should be, but an unwonted zeal is manifested now that a portion of the grant depends upon its being satisfactorily taught, and I much wish that such a proviso existed in regard to the needlework of the elder children. It is impossible, I think, to overestimate the importance of this part of a girl's education; and the chorus of disapproval which greeted the first needlework schedule, and from which the present one has not wholly escaped, was, in my opinion, a clear indication that some reform was called for in this respect. Constant practice has made me pretty familiar with the mysteries of what I formerly regarded as an occult art; but, at the risk of repeating a truism, I must say that the examination and criticism of needlework cannot be considered as one of the legitimate functions of her Majesty's Inspectors, and I hope before long this duty will be entrusted to more competent judges. Under the existing régime I am appealed to on all sorts of technical points, and I have often some difficulty in preserving my gravity, especially when garments more useful than ornamental are produced for my inspection."—Mr. Bernay, Durham District, pp. 227-8.

VOYAGE OF THE *ANTHRACITE*.

The following notice of Mr. Perkins's yacht, *Anthracite*, is taken from an American paper:—

"The steam yacht, *Anthracite*, which arrived at Falmouth, England, on the 14th, after a passage of twenty-three days from Philadelphia, is the smallest steam vessel that ever crossed the Atlantic. Her ability to make so long a trip is due to a new application of the principle of high steam pressure. Prior to 1861 it was found next to an impossibility to combine, in a boiler intended for generating steam at high pressure, strength and safety with durability. This was caused by injury that followed the introduction of the impurities contained in the water. With a boiler similar to the one on the *Anthracite*, all danger from corrosion is obviated, for the quantity of water necessary is reduced to the minimum by reason of its being used over and over again, so that even vessels of the largest tonnage could easily carry an adequate supply within a very small stowage space. It is a fact, proved by the records of transatlantic steamship lines, that the consumption of coal is in exact proportion to the increase of pressure upon the boiler, high pressure requiring the least fuel, and *vice versa*. The old steamers of the Collins line, and even the earlier vessels of lines now in existence, consumed a quantity of fuel proportionately much greater than that used by the fastest ships of the White Star line to-day. Since the days of Watt and his contemporaries, the use of steam at higher pressures has been looked upon as the true means of combining a larger amount of work with a more economical consumption of fuel. Newcomen used steam of barely more than atmospheric pressure; Smeaton raised the pressure a little, and found the work done to increase considerably; Watt used a pressure of ten pounds, and did three times more work than Newcomen; accomplished, and so on step by step, pound by pound, the inventors advanced until the higher pressure now used on the ocean steamers was reached. The experiment, which in the case of the *Anthracite* has proved so successful, involves a new development of this principle,

and the result may be a revolution in the history of steam navigation. The boilers of that little steam vessel are of the most compact construction, and have been tested with a pressure of two thousand five hundred pounds per square inch. Her usual working pressure is from three hundred and fifty to four hundred pounds, with a consumption of one ton of coal per day. Ocean steamers of the dimensions of the *Britannic* or *Germanic*, which now rarely consume less than one hundred tons of coal per day, instead of giving a large proportion of tonnage space to the requirements of fuel, will, with the high pressure system, make their passages on half or one-third the coal now consumed, and thereby not only increase their capacity for the carriage of freight, but make an enormous saving in the item of running expenses. To steam yachts the new principle will be invaluable. There have recently been built at Philadelphia and on the Hudson a number of these vessels, notably, the *Stranger* and the *Corsair*, belonging to Messrs. Osgood and Osborne, and there is now in course of construction at the yard of Messrs. Ward, Stanton and Co., at Newburg, a composite boat for the use of Mr. Pierre Lorillard, which is intended to be exceptionally fast, but so far as we know, there has been no application of the invention upon which the *Anthracite* is built. When this invention comes into general use, as from the success of the *Anthracite* experiment it is certain to do, we may expect to see yachts of a smaller tonnage making cruises which are now possible only to vessels of the largest capacity, while the ordinary ocean-going passenger vessels will be able, not only to increase their storage for freight, but to make the most profitable saving of fuel. The question of the safety of the high pressure principle naturally arises in this connection, but the mechanical ingenuity which raises such problems is generally equal to the emergency of solving them satisfactorily."

ARTISANS' INSTITUTE.

The report of the Artisans' Institute for the year 1879-80 has just been issued. It is signed on behalf of the trustees of the institute by Mr. Hodgson Pratt, the treasurer. It states that the trustees have every reason to be satisfied with the progress made by the institute, the object of which are described as being "the systematic instruction of apprentices and workmen (1) in the principles of art and science forming the basis of various handicrafts; and (2) in the technical application of those principles to actual work. In other words, the object may be stated as that of affording combined instruction in principles and practice, the one illustrating the other." The report argues that an institution of this sort is necessary for proper technical instruction. "When, however, instruction in the details connected with handicrafts is recommended, an off-hand reply is too generally given that the ordinary workshop is the proper school for practice, and that a 'science and art school' affiliated to South Kensington suffices for instruction in principles. This view, however, is not borne out by the statements of skilled artisans. They assert, on the one hand, that the industrial education of apprentices in the workshop is, in these days, altogether neglected; that no one takes the trouble to teach them anything; that they can only pick up a very superficial knowledge of their trades; that they are often mere drudges, or are employed in but one branch of the business, so that if that branch ceases to be required—as often happens—they have nothing to fall back upon. On the other hand, it is asserted that a large proportion of imperfectly-educated lads or grown men who join science and art classes find that they are unable to apply in the workshop what is taught in the class-room, and only half understand what is taught, for want of seeing principles illustrated by their application to work." The institute has been subsidised by the City and Guilds Technical Institute, the committee of which have requested the trustees to carry on the work for a year, while guaranteeing the greater part of the expenses. There are nine classes, the number of students attending them being 151. It is not, however, stated what is the actual number of students belonging to the institute.

According to the balance-sheet appended, the institute expended £360 during the year, while receiving from all sources £387. Of this £387, £250 was a contribution from the City Institute, £29 for sub-letting their hall, and £30 for class fees. The remainder is made up of a donation from the Clothworkers' Company of £21, and one from the Fishmongers' Company of £50, with a few smaller contributions. The institute appears to have paid off part of a debt due to the treasurer, though it still owes him £25; it is also in debt to Mr. Morley, one of the trustees, to the amount of £50.

PROFESSOR MAX MULLER ON PROGRESS.

At the opening of the Mason Science College at Birmingham, Professor Max Muller made the following remarks:—

"The spirit in which this college has been founded strikes me as a truly liberal spirit—a spirit of faith in the future, a spirit of confidence in youth. Much as I admire the enlightened generosity of the venerable founder of this college, nothing I admire more than one clause in the statutes which states that, with the exception of a few fundamental provisions, the trustees not only may, but must from time to time so change the rules of this institution as to keep it always in harmony with the requirements of the age. You know how other colleges and universities have suffered, have been hampered in their career of usefulness, by the wills of pious and faithful founders and benefactors. Now here, in the founder of this college, we have a truly faithful founder—a man who has proved his faith in the future and his confidence in youth—who is convinced that in the long run the path followed by mankind will be the right path; nay, that those who come after us will be, as they ought to be, wiser and better than ourselves. We who are growing older ourselves know how difficult it sometimes is for an old man to have faith in youth and confidence in the future. Yet that firm faith in youth, that unshaken confidence in the future, seems to me to form the only safe foundation of all science, and on them, as on a corner-stone, every college of science ought to be founded. The professors of a college of science should not be conservative only, satisfied to hand down the stock of knowledge, as they received it, as it were, laid up in a napkin. Professors must try to add something, however little it may be, to the talent they have received; they must not be afraid of what is new, but face every new theory boldly, trying to discover what is good and true in it, and what is not. I know this is sometimes difficult. Young men with their new theories are sometimes very aggravating. But let us be honest. We ourselves have been young and aggravating too, and yet on the whole we seem to have worked in the right direction. Let us hope, therefore, that the professors of this college will always be animated by the spirit of its founder, that they will never lose their faith in progress, never bow before the idol of finality. Let them always keep in the statutes of their own mind that one saving clause in the statutes of this college—to keep pace with the progress of the world. By that clause, by that profession of faith in the future, Sir Josiah Mason has done honour to himself and honour to posterity. Let him rest assured that such faith is never belied, and that rising and coming generations, while applauding his munificence, will honour and

cherish his memory for nothing so much as for that one clause in which he seems to say, like a wise father, "Children I trust you."

The whole of the Professor's speech is reported in the *Times* of 5th October.

SANITARY RULES FOR PUBLIC BUILDINGS.

The following rules, to be observed in the construction of all buildings erected under her Majesty's Office of Works, have been prepared and issued by the Secretary to the Office of Works:—

1. All water-closets and urinals shall be constructed so that one wall at least of such closets and urinals shall be an outer wall of the building. 2. All soil pipes shall be carried outside the building, and ventilated by means of pipes leading the foul gases above the highest point of the building. Such pipes to be carried to points removed from chimney stacks. 3. Separate cisterns shall be constructed for the water-closets and for the general purposes of the building. No tap or "draw off" shall be affixed to any pipe communicating with a cistern supplying a water-closet or urinal. 4. All waste pipes and overflow pipes of cisterns shall terminate in the open air, and be cut off from all direct communication with drains. 5. Great attention shall be paid to insuring through ventilation in all rooms. Rooms so high that their ceilings shall be more than two feet above the top of the windows, corridors, staircases, and other open spaces shall be specially ventilated so as to prevent the accumulation of stagnant air. 6. All main drains should, where practicable, be formed outside the building. In the event of its being necessary to carry a main drain underneath a building, it must be trapped immediately outside the main wall, and a ventilating pipe must be carried from that point to the highest part of the roof, as under rule 2.

NOTES ON BOOKS.

A Physical Treatise on Electricity and Magnetism, by J. E. H. Gordon. London: Sampson Low, and Co., 1880.

Mr. Gordon's object, as stated by himself, is, while treating his subject completely, to treat it from a physical, rather than a mathematical, side. "No mathematical knowledge," he says, "is required, except that of algebra up to simple equations," for the understanding of the text of the work. Following the usual practice of this *Journal*, no criticism on the book will be attempted, but the following brief notice may serve to show what are its principal contents.

Mr. Gordon divides his subject into four parts—Electrostatics, Magnetism, Electro-kinetics, and Electro-optics. The first part is to a large extent introductory; it deals with frictional electricity, describing the usual machines and explaining their action, then it passes on to the consideration of quantity, potential, force, and density; next are some chapters on measurement, and at the end of the part, a long chapter on "Specific Inductive Capacity," a subject to which it is well known Mr. Gordon has devoted special attention. Part II, "Magnetism," comprises an elementary description of the phenomena, a brief history of the subject, and an account of the most recent investigations therein. In Part III, "Electro-kinetics," we get to voltaic electricity. Mr. Gordon contents himself with describing a few selected forms of battery, including Grove's, the bichromate, Smee's, Daniell's, the gravity battery, Mr. De la Rue's chloride of silver battery, &c. The American battery, brought out a few years ago, in which a current of air is driven through the solution, is honoured with a place in the list, without any reference to the various older inventions of the same character. An account of the action of currents on magnets leads to an account of the principal galvanometers. The subject of telegraphy is not treated in this or in any other part of the book, which deals throughout not so much with the practical applications of electricity as with the theory of the science. Chapters follow on "Electro-Magnetic Units" and the "Measurement of Resistance." A chapter on "Electro-Magnetism" leads to one on the "Telephone," with which is associated the Microphone of Hughes. The Bell telephone is the only one mentioned. Mr. Hughes' induction balance forms the subject of the succeeding chapter. Then follow observations on electro-magnetic induction, the B. A. unit of resistance, mutual action of currents, induction. This closes the first volume. The second volume, still continuing the division of "Electro-kinetics," begins with a chapter on "Standard Coils." "Diamagnetism" is next treated, and then we come to the Induction Coil. Amongst others, Mr. Spottiswoode's great coil is described. A chapter on "Striæ," and one on "The Sensitive State of Discharges through Rarefied Gas," lead on naturally to a full account of Mr. Crookes's investigations into the phenomena of very high vacua. Electrolysis is the next part of the subject, and this, in accordance with the plan adopted, is only considered in its theoretical aspect. After an account of Planté's researches on secondary batteries, we come to a chapter on magneto-electric and electro-magnetic machines, which are very briefly treated, as is also the electric light. The concluding chapters of this part deal with "Thermo-electricity," "Electricity of Contact," "Dimensions of Units," "Comparison between Electo-static and Electro-magnetic Units." The fourth and last part of the book treats of the relation between magnetism and polarised light, and the effect of light in varying the conducting power of selenium. The book throughout is very fully illustrated, both by plates and by woodcuts. Some of the plates illustrating the discharge through vacuum tubes are coloured.

GENERAL NOTES.

Patent Reform.—A public meeting was held at Birmingham, on 26th October, to do honour to Mr. Chamberlain, its member, and now President of the Board of Trade. Speaking of the work to be done in the next Session of Parliament, he said "there was the Patent-law, which, in his opinion, was unjust to many inventors," who will, doubtless, lay to heart Mr. Chamberlain's opinions.

A Food Exhibition, held at the Agricultural-hall, Islington, during the week ended the 23rd October, appears to have been a great success. It was chiefly remarkable for the evidence it afforded of the growing extent of imports of food preserved by all kinds of methods. The goodness of these was demonstrated in lectures given by Miss Smithard, certificated by the National Training School for Cookery, who has established a school at Brighton. A jury, consisting of Dr. Bartlett, Dr. Tripe, Mr. Wigner, the Analyst for Woolwich, Dr. Hardwicke, &c., awarded numerous gold, silver, and bronze medals. The idea was first started at the International Exhibition of 1874. A second exhibition is announced for next year.

MEMBERS' SUBSCRIPTIONS.

The Michaelmas subscriptions are now due. Cheques or Post-office orders for the above should be made payable to H. T. Wood, or order, crossed "Coutts and Co."

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All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ARRANGEMENTS FOR THE SESSION.

The first meeting of the One Hundred and Twenty-seventh Session of the Society will be held on Wednesday, the 17th inst., when the Opening Address will be delivered by F. J. BRAMWELL, F.R.S., Chairman of the Council. Previous to Christmas, there will be four ordinary meetings, in addition to the opening meeting.

Candidates proposed for election as members are privileged to attend the opening meeting.

ORDINARY MEETINGS.

The following arrangements for the Wednesday evenings before Christmas have been made:—

NOVEMBER 17.—Opening Meeting of the Session. Address by F. J. BRAMWELL, F.R.S., Chairman of the Council.

NOVEMBER 24.—"The Influence of Barry upon English Art." By J. COMYNS CARR.

DECEMBER 1.—"The Photophone." By W. H. PREECE, Pres. Soc. Tel. Engineers.

DECEMBER 8.—"London Fogs." By Dr. ALFRED CARPENTER.

DECEMBER 15.—"The Use of Sound for Signals." By E. PRICE EDWARDS, Secretary to the Deputy-Master of the Trinity-house. On this evening Dr. TYNDALL, F.R.S., will preside.

At the Meetings after Christmas, the following papers, among others, will be read:—

"Buying and Selling; its Nature and its Tools." By Prof. BONAMY PRICE. On this evening Lord ALFRED S. CHURCHILL will preside.

"The Participation of Labour in the Profits of Enterprise." By SEDLEY TAYLOR, M.A., late Fellow of Trinity College, Cambridge.

"The Gold Fields of India." By HYDE CLARKE.

"Flashing Signals for Lighthouses," By Sir WM. THOMSON, F.R.S.

"The Present Condition of the Art of Wood-carving in England." By J. HUNGERFORD POLLEN.

"Ten Years' Experience of the Working of the Trade Mark Act." By E. C. JOHNSON.

"Trade Prospects." By STEPHEN BOURNE.

"The Manufacture of Aërated Waters." By T. P. BRUCE WARREN.

"The Compound Air Engine." By Col. F. BEAUMONT, R.E.

"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"Indian Agriculture." By W. R. ROBERTSON.

"Trade Relations between Great Britain and her Dependencies." By WM. WESTGARTH.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock:—

February 1, 22; March 15; April 5; May 10, 31.

APPLIED CHEMISTRY AND PHYSICS SECTION.

The meetings of this Section will take place on the following Thursday Evenings, at Eight o'clock:—

January 27; February 24; March 24; April 7, 28; May 26.

INDIAN SECTION.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock:—

January 21; February 11; March 4, 25; April 29; May 13.

CANTOR LECTURES.

The First Course will be on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Prof. A. H. CHURCH, F.C.S. Five Lectures.

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

The Fourth Course will be on "The Art of Lacemaking," by ALAN S. COLE. Three Lectures.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

Syllabus of the First Course.

LECTURE I.—NOVEMBER 22.—Bricks, tiles, and unglazed terra-cotta in general.

LECTURE II.—NOVEMBER 29.—Vitreous, plumbiferous, boracic, and felspathic glazes and enamels. Iridescent and metallic lustres, and colouring substances.

LECTURE III.—DECEMBER 6.—Stoneware and other wares glazed with salt.

LECTURE IV.—DECEMBER 13.—Soft paste porcelains. European and Oriental.

LECTURE V.—DECEMBER 20.—Hard paste porcelain. Chinese, Japanese, and European.

JUVENILE LECTURES.

The usual short Course of Lectures adapted for a juvenile audience will be given by G. J. ROMANES, F.R.S., on "Animal Intelligence." The dates

for the lectures will be 29th December and 5th January. The lectures will commence at 7 o'clock. Special tickets will be issued for these lectures.

Admission to Meetings.

Members have the right of attending all the Society's meetings and lectures. They require no tickets (except for the Juvenile Lectures), but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

Annual General Meeting.

The Annual General Meeting will be held on June 29th, at four o'clock.

The following is a table of dates of the Evening Meetings of the Society, subject to such alteration as may be found necessary:—

	CANTOR LECTURES.	FOREIGN AND COLONIAL MEETINGS.	ORDINARY MEETINGS.	APPLIED CHEMISTRY AND PHYSICS MEETINGS.	INDIAN MEETINGS.
1880.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
November	— — 22 29 —	— — — —	— — 17 24 —	— — — —	— — — —
December	6 13 20 — —	— — — —	1 8 15 — —	— — — —	— — — —
1881.					
January	— — — — —	— — — —	— 12 19 26 —	— — 27 —	— — 21 —
February	7 14 21 — —	1 — — 22	2 9 16 23 —	— — 24 —	— 11 — —
March	7 14 21 28 —	— 15 — —	2 9 16 23 30	— — 24 —	4 — 25 —
April	— — — 25 —	5 — — —	6 — — 27 —	7 — 28 —	— — 29 —
May	2 9 16 23 30	— 10 — 31	4 11 18 25 —	— — 26 —	— 13 — —

The Chair will be taken at Eight o'clock at each of the above Meetings.

MUSICAL COMMITTEE.

The following, which is the third Report of the Committee on the National Cultivation of Music, has been presented to the Council:—

1. The Musical Committee gave briefly, in their second Report, a short notice of—1. The origin of the National Training School for Music. 2. The memorial presented by the school to the Commissioners of the Exhibition of 1851 for assistance. 3. The negotiations of H.M. Commissioners with the Royal Academy of Music, which led to no result, as in former years. 4. The hope expressed by the Society of Arts, in 1873, that the National Training School might be engrafted on the system of national education. 5. The publication of the Society's directory for establishing local music schools; and 6. The change in the Education Code proposing to grant 1s. for singing from notes, or 6d. for singing by ear.

2. The Musical Committee now proceed to consider the following documents, which have an important bearing on the national cultivation of music as promoted by the Society of Arts:—

I.

"3. The report on the examinations held by the Society of Arts in 1880, from which it appears that 176 candidates presented themselves for examination in the metropolis, and 420 in the provinces, making a total of 596 candidates, who obtained 180 first certificates, and 272 second certificates. These, added to the numbers of candidates since 1859, when the examinations commenced, makes a total of 2,496.

II.

4. The Education Code for 1880, issued by the Duke of Richmond and Lord George Hamilton, in which the passage relating to singing is printed as follows:—"§ 19, A. (2) 1s. (or 6d.) if singing from notes (or by ear) forms part of the ordinary course of instruction." Also,

III.

5. The Education Code for 1880, issued by Earl Spencer and Mr. Mundella, which restores the words of the Code of 1879, "§ 19, A. (2) 1s. if singing forms part of the ordinary course of instruction." These words were first used in the Code of 1874, instead of the words of the Code of 1872, issued by the Earl of Ripon and Mr. W. E. Forster, which were as follows:—"§ 19 a, the sum of 16s. per scholar, according to the average attendance, was to be paid, but might be reduced, 'Art. 32 d, by one shilling per scholar,' unless *vocal music* forms part of the ordinary course of instruction." The same rule was kept in the Code of 1873.

6. These facts show the change of views in the Department from time to time. The Committee are of opinion that the Code of 1872 was right in principle, and that some such rule, as established in the first Code issued for 1880, is most desirable for the national cultivation of music.

IV.

7. Extracts of the opinions of inspectors of schools on singing, which are printed in the *Journal of the Society of Arts*, No. 1,428, vol. xxviii., p. 405, also No. 1,453, p. 846.

8. The Committee recommend that these extracts, thus classified, be sent to the Lord President and Vice-President of the Committee of Council on Education, with a request that, in future, the opinions of all the inspectors on music be brought together and published.

V.

9. Returns to the House of Commons, 4th April, 1879, moved by Sir Charles Dilke, showing an expenditure of £119,129 18s. paid in respect of grants for singing, in 1878; also for grants paid in 1879, showing an expenditure of £128,680 10s.

VI.

10. Copy of all memorials sent to the Education Department on the subject of musical instruction in public elementary schools, and the answers made thereto by the Department, published in the return to the House of Commons, 24th June, 1878, moved for by Sir Charles Dilke. The return gives—1. The memorial of the clergy resident in and near Man-

chester, signed by the Bishop of Manchester and ten clergymen near Manchester. 2. The memorial of the Manchester Diocesan Board of Education, signed by the Bishop of Manchester as President. 3. National cultivation; system of instruction for elementary schools, suggested by Dr. Burton and the Rev. E. Preston, Anderson Precentor of the Manchester Gregorian Choral Association. 4. Memorial from the School Board of Balfron, Scotland. 5. Memorial of the School Board of the district of the City of Manchester, signed by Herbert Birley, chairman, and F. O. Ruspini, clerk.

VII.

11. Suggestions for an improved administration of the grant for singing submitted by Mr. Alan S. Cole, a member of the Musical Committee, and printed by the Society of Arts, 31st December, 1877.

12. The Committee consider the principles herein suggested to be deserving of the attention of the Lords of the Committee of Council on Education.

13. Dr. Hullah, in his published Memorandum Report on Education, 1873, p. 548, suggests that from the fifty-one training schools in England and Scotland, "a selection of a limited number be made annually of those students who, at the end of their two years' training, show the most skill in and aptitude for music, and that these be placed in the Royal College during a period not exceeding 12 (?) months, for the purpose of carrying further their musical studies, in classes expressly arranged for them, and otherwise participating in its advantages. The students would, at the close of their residence, receive testimonials of their qualifications as musical instructors, and should then be placed in large towns or other centres, in which they might teach music in the upper classes of elementary schools, and aid and direct the teaching in the lower. That the annual inspection of schools, so taught, be made by or under the direction of the professors of the Royal College, and that the annual grants for efficiency in music now made by the Education Department be, in future, awarded to each school on the reports of such professors."

14. The Committee view Dr. Hullah's proposals as suggesting the creation of a central and paternal system, different from any which exists at present in this country. It would seem to divide the responsibility for the expenditure of public money between the Government Education Department and the proposed College of Music, "*i.e.*, the annual grants now made by the Education Department." It would seem to limit the choice of teachers to be trained at the public expense to teachers in the training colleges, who do not enter the training school on account of any special musical ability. If this be so, the Committee submit that the competition to enter any public music school should be open to the whole public. Dr. Hullah also proposes "that the musical instructors should be placed in large towns or other centres." Is the State "to place" them, or the localities?

15. The Committee are of opinion that, according to the wishes of the locality, the locality itself, whether Board or denominational school, mechanics' institute, &c., must appoint, dismiss, and pay any instructors they think fit, who may or may not have been trained at the public expense, directly or indirectly, provided they have been certificated as competent by an impartial authority.

16. Further, it would seem objectionable that the proposed College of Music should not only train, but inspect, besides "awarding the Parliamentary grants."

17. The Committee venture to express a hope that the Government, through the Lord President of the Council, will appoint and pay any inspectors where public grants are concerned. The Committee cannot but think that Dr. Hullah has not sufficiently considered the principles on which public money is awarded by the Science and Art Department to encourage science and art teaching. The Committee recommend that these principles modified, "*mutatis mutandis*," should be applied to the national cultivation of music, and they agree with the numerous authorities (see first Report of this Committee *passim*), who advise that the science and art of music be placed under the Science and Art Department, and examinations be held and certificates granted, as in Art.*

18. The Musical Committee would point out that their first Report shows rules by which a system may be administered, and they are informed that Watford has successfully started, under the Public Libraries Act, a music school on the principles recommended in the report.

19. Sir Charles Dilke moved for a return, in 1879, of the number of teachers employed in 1878 who held training college certificates of competency to teach music, but he could not obtain it because no certificates were granted. The Musical Committee recommend that the Committee of Council on Education should institute a system of granting certificates at the next examination of training colleges, and that arrangements may be made for examining teachers now employed in elementary schools, and others who may present themselves, and that certificates of competency to teach elementary music may be granted as soon as practicable. The committee consider this work to be of the very first importance in reforming the present imperfect system.

VIII.

20. Dr. Hullah's "Memorandum on Music" in elementary schools and the Royal College of Music, printed in Education Reports for 1879-80.

IX.

21. An Act to amend the Public Libraries Act (Ireland) 40 and 41 Vict., c. 15, June, 1879. By § 3—It is enacted that the terms, "Science and art," and schools of science and art, "used in the said principal Act, shall be deemed to include the *Science and Art of Music and Schools of Music* respectively," and a rate may be applied "towards the maintenance and support of, and payment of the salaries of teachers of, a school or schools of music, and the purchase of musical instruments, books, and other requisites for the use of such school or schools." The Committee strongly recommended the Council to petition Parliament, praying that a similar privilege should be given to England and Scotland, and express a hope that the Government will cause an Act to be passed.

X.

22. The Charter of the Royal Academy of Music, granted in 1830, and printed in Report of the Society's Committee of Musical Education, published June, 1866. The Royal Academy of Music, at the present time, owing to the direct management of the professors, possesses an annual income of about £13,000 a year.

XI.

23. Copy of petition of H.R.H. the Prince of Wales, praying for the grant of a Charter of Incorporation to the Royal College of Music, and draft of the charter prayed for, printed in the Society's *Journal*, No. 1,455, vol. xxviii., p. 868.

24. The Committee notice the Charter chiefly, so far as it seems likely to affect the work of examinations, which has been so long carried on by the Society of Arts; and the following passages are extracted from the Charter, which seem to call for some remarks, which the committee trust they may be permitted to submit as useful:—

* See First Report:—Rev. H. D. de Brisay, Principal of the Oxford Training College, p. 6; Rev. J. C. Evans, Principal of the Home and Colonial School Society, p. 7; Rev. Evan Daniel, Principal of St. John's Training College, Battersea, p. 8; Rev. D. Ross, Principal of the Church of Scotland Training College, Glasgow, p. 9, &c.

Purpose of the Corporation.

25. The purpose for which the Corporation is founded is stated to be—

1. The advancement of the art of music.

(*a*) By means of a central representative body,

(*b*) Charged with the duty of providing musical instruction of the highest class,

(*c*) And having a capacity to exercise a powerful influence on the cultivation, practice, and regulation of the art and science of music;

(*d*) And, further, having in view the promotion and supervision of musical instruction in elementary schools and elsewhere, as may be thought most conducive to the cultivation and dissemination of the art of music in the United Kingdom.

Under the Conduct of Business.

2. (*a*) The Council may enter into any engagements with the Government respecting musical instruction in elementary or other Government schools,

(*b*) Including the inspection of schools,

(*c*) The conduct of examination,

(*d*) The providing wholly or partially for the supply or education of musical teachers,

(*e*) The appropriation of scholarships or otherwise to persons educated in such schools,

(*f*) And any other matter in relation to the promotion of music in connection with Government, and which may be thought expedient.

3. (*a*) The Council may negociate with any musical bodies as to the conditions on which they will be willing to join the Corporation;

(*b*) May affiliate any musical schools or societies with the Corporation, or affiliate the Corporation with any existing university;

(*c*) Power to create a home, and to provide therein, wholly or partially, maintenance for scholars or Government pupils.

26. Upon § 1 (*c*) the Committee would venture to observe that "the art and science of music" are progressive, like all other arts and sciences. To influence the regulation of them would seem to be somewhat beyond the powers of any human authority. Cultivation and practice, according to varieties of system and views of the time, are possible, but any kind of dogmatic regulation would seem to be impossible, and, if attempted, would certainly be resisted by the public.

27. The Committee observe that the functions which the council of the college are authorised to exercise, appear to be those of a university rather than a college. A college has to teach. A university examines and confers degrees upon members of colleges and affiliates institutions to it.

28. For imparting direct instruction in the science and art of music to the public at large in the metropolis, the proposed college will find competitors in the Royal Academy of Music, in Trinity College, in the London School of Music, in the New Guildhall School, and others; but the training of teachers, who are necessary to national cultivation for all classes of the people, is a special duty undertaken by no other institution than the present National Training School, and having been started successfully by the Society of Arts, after fourteen years' careful watching of musical education, the Committee, in accordance with the suggestion of H.R.H. the Prince of Wales, in his petition that "any other name may be adopted," would venture to recommend the Privy Council, whilst adopting any new title, to preserve the name of the National Training School of Music.

MISCELLANEOUS.

INTERNATIONAL EDUCATIONAL CONGRESS, BRUSSELS.

The meeting of this Congress, in connection with the celebration of the 50th anniversary of Belgian independence, was held at the Athénée Royal, from 22nd to 29th August. A collection of educational works, used in the Government schools of Belgium, had been made by the Office de Publicité, Brussels; and an exhibition of school furniture and appliances, in competition for prizes, was also organised. Among the latter were drawings, for the purpose of giving "object lessons," besides models, maps, globes, and other appliances.

The *présidence d'honneur* was awarded to M. P. Van Humbeeck, Minister of Public Instruction; M. A. Couvreur, member of the Chamber of Representatives, was President; M. P. Tempels, President of the Ecole Modèle, Vice-President; and M. Charles Buls, Alderman of Public Instruction for Brussels, general secretary. Nearly all the countries of Europe were represented by correspondents, nominated by the Executive Committee, and several Governments and Municipalities sent delegates. Though England was not represented officially, several distinguished English educationalists were present.

The Congress was opened by **M. Couvreur**, president, who said that the only practical method of dealing with educational problems was that which, in the Government schools, was taking the place of abstract reasoning and logical deductions, viz., the seeking out, study, and comparison of facts, no principle being laid down unless it was based upon previous observation often repeated. This was the reason why the organisers of the Congress had demanded that it should be conducted like a Commission of inquiry, and not pass resolutions, which often require to be reversed; but that it should merely collate facts, experience and arguments, leaving to time and practice the care of proving and confirming the data.

M. Van Humbeeck, Minister of Public Instruction, and Honorary President of the Congress, after giving a hearty welcome to the foreign delegates and members, said that, to increase the moral and intellectual value of the country, they hoped to ensure the benefit of primary instruction to all the inhabitants. After this elementary education, came technical or literary studies, and then philosophy, natural science, physics, mathematics, medicine and law, in all of which important changes were required, as the consequence of modifications in the methods of elementary instruction. Observation and experiment should occupy a large proportion, when more fruitful results would be attained; for the pupil, not merely becoming acquainted with known discoveries, but to some extent making the discoveries for himself over again, would feel rise within him the spirit of study and investigation.

M. Ch. Buls, Alderman for Public Instruction, and general secretary, then traced the history of the Congress. The *Ligue de l'Enseignement* was founded sixteen years ago in a purely national interest, but, by degrees, its labours enlisted sympathy from abroad; so that, in connection with the fiftieth anniversary of the nation's separate existence, it was decided to invite the co-operation of all who were interested in the great work of education. On 19th February, 1880, the executive committee was named, the rules were adopted, and collaborateurs sought in all the countries of Europe. He mentioned as specially entitled to recognition the services of the gentlemen who have acted as correspondents for their respective countries.

The Congress was divided into six sections, as follows:—1st, *Crèches*, kinder-gärten, infant schools, and elementary instruction; 2nd, secondary education; 3rd, superior education; 4th, special, professional, technical, agricultural, and commercial instruction; 5th, the instruction of adults, classes, lectures, libraries, museums, societies for the propagation of instruction; and 6th, school hygiene. Each Section held a morning sitting; and, in the afternoon, the whole Congress deliberated on a question belonging to each of the Sections in turn.

Elementary Education.

The first Section was subdivided into two divisions, the first of which was chiefly engaged on the general organisation of popular education, and the second on the Frœbel system and the different methods of applying it. The united Sections, under the presidency of **M. Jottrand**, dealt with the following questions:—"What is the object which the Legislature should pursue in elaborating the programme of primary instruction; and what are the merits of the old and new systems?"

M. Salicis (Paris) considered that, for the labouring classes, manual should go hand in hand with mental instruction, and gave an account of his successful attempt in this direction at a school in the 5th Arrondissement, Paris.

Mr. A. Sluys, director of the Ecole Modèle, Brussels (which the members visited during class hours), was of opinion that, besides reading and writing, instruction that will be useful in after life should be imparted.

Mr. Vercamer, inspector of primary instruction, expressed the hope that (1) some practical means would be found for keeping the child of the people at school after 12 years of age, and (2) that no primary school be established without an evening school.

Other speakers expressed the opinion that political and social knowledge should be taught in schools.

Herr Hatt, inspector of schools in Alsace, considered that there was a reform to be accomplished, by beginning the primary school in the infant school, which would complete the kinder-garten.

Secondary Education.

The principal question before the second Section was:—"Should the course of secondary education have relation to the higher branches of special study which each pupil is intended to pursue, or should they be conceived with a view to a preliminary general culture, common to all the special branches of study? (*a*.) In what proportion should the time be divided between the subjects relating to literary culture, and those connected with scientific attainments? (*b*.) In what proportion should the time be divided between the mother tongue and modern and ancient languages?"

The subject was introduced by a report contributed by **Prof. Stecher**, of the Liége University, who observed that there are now two systems of education, that of the humanities and that of utilitarianism, the first tending to form men, and the second to recruit the various trades and professions. Opinions are agreed in regarding the school as the apprenticeship of life; but its method is viewed in different lights by the *humanists* and by the *realists*, as they are called in Germany. The former, considering that the school should enlighten the reason, fortify the will, elevate the conscience, discipline the faculties for work and study, inspire order and method, and develop the aspirations, recommend the study of Greek and Latin as the best means of attaining these ends. The realists, on the other hand, admit nothing but a completely special education, and assert that the battle of life, becoming more arduous every day, requires that secondary instruction should be limited to that which is strictly necessary for each individual, reducing it, in fact, to a technical apprenticeship. Between humanists and realists are ranged the partisans of a modern pedagogic system, who endeavour to reconcile what is due to the man and what is claimed by society. By concentration, that is to say, by an harmonious arrangement and due proportion of the various subjects of instruction, an attempt has been made to maintain and even extend the field of study without surcharging the programme or overwhelming the student.

M. De Heesen (the Russian delegate) examined the two different kinds of secondary schools that now exist; the classical schools and the special schools, that is to say, the technical sections of the colleges. Russia, anxious to organise a system of secondary instruction, had for some years past studied the working of these schools in other countries. In Austria, the superiority of the classical schools was not contested; and in Germany this superiority was proclaimed by the most eminent authorities. The partisans of professional schools insisted on the importance of mathematics; but it appeared, from official statistics published in Germany, that the pupils of classical schools evince much greater facility than all others for the higher studies, even technical and scientific. Similar evidence was given by other countries, and the speaker's own observation led him to arrive at the same conclusion.

Superior Education.

The necessity of an examination previous to entrance in the universities was unanimously acknowledged; but it was not thought advisable to fix a minimum of age, so long as the desired knowledge was acquired.

On 25th August, the vice-president, **M. Houzeau**, took the chair.

The question belonging to the third Section, treated in general assembly, was:—"Should the object of higher instruction be limited to the acquisition of professional aptitude? (*a*.) Should not university studies be regarded as destined to spread abroad among the higher classes of the community the essential details of all the sciences, and thus concur in the general culture of the whole nation? (*b*.) Is it advisable, with a view to the progress of science, to arrange higher studies outside the programme of the present branches of study at the universities; and how should they be organised?"

Dr. de Roubaix, in opening the discussion, proposed to limit his observations to Belgium. He considered the first duty of the universities was to turn out skilful practitioners; they should popularise science, expound the sciences in their integrity, and favour laboratory practice. The programme arranged in Belgium generally fulfilled these conditions; but a reproach, not unfounded, was brought against the universities, that pure science was sacrificed to practice. He advocated the establishment of a public and central institute of improvement, similar to those in Germany, annexed to the universities, which, he contended, would gain rather than lose by the addition, their laboratories receiving a better organisation than the insufficient one they have at present.

Dr. Crocq, Professor at the Free University, Brussels, spoke in connection with his report on this subject, in which he divides human faculties into two distinct categories, superior and inferior. To the first belong the intellectual aptitudes and their manifestations, thought, sentiment, science, art, and æsthetics; and the second may be summed up in nutrition, the maintenance and exercise of the organs, and the material motion of the organisation. This is the ancient distinction between the mind and the body, both belonging to man, but the second only to animals. On this distinction, which could not be denied, whatever view one might take of nature, depends the principle on which it must be determined whether the higher studies should be limited to the acquisition of professional aptitude. That which characterises superior education is not

so much the matter as the manner of instruction; because many branches of study—physical science for instance—may be taught first in its elements to children, then connected with secondary instruction, and afterwards be thoroughly developed in superior education. What are the characteristics of superior education? To teach science completely in its fullest extent, so as to place the student in a position to apply it to the requirements of everyday life, and to aid its progress by his own labours. From this point of view, universities properly so-called, as they exist in Belgium, Holland, Germany, Sweden, Switzerland, and Italy, are vastly superior to the special schools and isolated universities met with in France and England. They bring about frequent meetings between the men who follow the different directions of intellectual activity, and also between the students, which meetings are eminently favourable to the general action of science, to elevated views, and to progress generally.

Technical Instruction.

It followed from the discussions of the fourth Section that the organisation of industrial schools should depend upon the nature of the industry that predominated in the locality to which the school belongs. Diminution in the manual dexterity of workmen was thought to be more apparent than real. The fear manifested on this head arose from the change which has taken place in the relation between the production and the technical knowledge of the workmen; production had greatly increased while the means of apprenticeship diminished. There was a tendency to introduce workshops into elementary schools, and to organise technical schools in connection with trade syndicates. The importance which the technical instruction of women has assumed led to the hope that it might be officially recognised; and that establishments be founded for fitting candidates for occupations suitable for their sex and aptitudes. The Section stated that the progress realised in the instruction of deaf mutes was so great, that they were no longer taught to correspond by signs.

The president of this Section was Colonel Adan, director of the Cartographic Institute of Belgium: the secretary, M. E. Rombaut, inspector of the industrial schools of the kingdom; and the *secrétaire adjoint*, M. Paul Davreux, engineer to the Musée de l'Industrie. The question to be treated in general assembly was as follows:—"What is the best organisation to give to academies or schools of design, so that art may fulfil, in the interest of the masses, its educational mission? Examine the question, from this point of view, for the instruction of design: (*a*), in secondary schools; (*b*), in elementary schools; and (*c*), in technical or industrial schools of all degrees for both sexes."

An answer to this question may be found in the report of Herr W. Rösler, professor at the Royal School, Vienna, who, however, was not present at the meeting. In the same way that reading, writing, and arithmetic were considered necessary subjects of instruction in all primary schools, so should drawing be considered an elementary principle in education. The object of instruction in drawing, like all other scientific teaching, should be to elevate and perfect the mind and the character, and not merely to convey the means of acquiring a certain manual dexterity. In all schools, except those especially connected with art, the only subjects treated should be the reproduction of forms capable of being turned to account in practice, those for instance required in the artistic professions. The task to be pursued should be to awaken and develop the knowledge of what is legitimate and rational, to elevate the intelligence and a love of the beautiful in its forms and colours, develop technical knowledge, and inculcate elementary knowledge of art and the artistic professions.

M. Desmoulins (Paris) considered the report too detailed, and not sufficiently general in character, and quoted Leonardo da Vinci's advice to pupils, to copy all they saw. The culture of design should be permanent in education, for drawing, like writing, was a method of giving expression and thought. He wished to see modelling classes introduced into primary schools; he would even like to see children learn the elements of some trades, everything, in fact, that was calculated to develop the mind by exercising the hand.

M. Dognée (Liége) had for many years claimed that all pupils should be initiated in the science of drawing, as art had a great mission in civilisation. The history of the past taught us that better work was executed formerly than now; and our duty was to revive that which there was of good in the old corporations, while, at the same time, eliminating what was contrary to the spirit of liberty. The State should intervene to provide instruction for developing industrial artists. He considered that design was not sufficient by itself, but that æsthetics should also be taught.

M. De Taye (Louvain) recalled the faults and insufficiency of ancient methods of teaching design, and showed the necessity of following up the schools by a complete system of instruction, in which aptitudes and special directions would only take their course after the elements of art had been acquired.

M. Francolin (Paris) deprecated the intervention of the State in matters of art, proclaiming absolute liberty in this respect. While, in France, the *Académie des Beaux Arts* had exerted a deplorable influence, societies and syndicates of workmen had, unaided, produced results that the State could never have achieved. Let the State intervene in forming museums and founding schools, but let the professors have complete liberty of action and teaching.

M. Trélat (Paris) pointed out the confusion that had arisen between plastic and geometrical drawing, which prevented an understanding being arrived at with regard to the teaching of drawing. He considered that the system of education should take into consideration these differences, and that plastic design should be reserved for those endowed with special aptitudes which it was important to discover and develop, without, however, forgetting the danger of a too great generalisation of geometrical drawing.

Adult Instruction.

Members of the fifth Section were agreed as to the distinction to be drawn between illiterate adults and those who have already some stock of knowledge, and also as to the difference in the programme for town and country. As to the organisation of workmen's societies, opinions were divided as to the recompense to be given to elementary teachers who gave their time to them.

On the subject of organising popular museums,

M. Charles Buls had prepared a detailed report in the style of Dr. Richardson's famous description of the model city of Hygeia. He observed that the greatest difficulties encountered by the child or the ignorant person, on the threshold of science, are the scientific terms, almost entirely taken from languages with which he is unacquainted; and a remedy was suggested in placing an object side by side with its name. He observed that a study of the ideal museum should result in a profound and exact knowledge of the æsthetic laws which the grand epochs of art have obeyed, so that they may be applied to our artistic conceptions. The department of each industrial art should be preceded by a technological collection, embracing the raw products, with tickets indicating their properties. The machinery hall should be devoted to the application of science, beginning with the physical and mechanical forces, with the various motions ranged after the natural forces on which they depend. The

capital of each country should possess such a museum; and provincial museums in the chief towns should possess casts and copies. Cantonal collections would have a local character, deriving their objects as far as possible from the mineralogy, fauna, flora, and industry of the surrounding country.

The question treated in general assembly, "What services can schools and workmen's societies render to the army, and what services can the army render to general instruction," formed the subject of two reports. The first, by Capt. G. du Nord, of Vienna, states that the school can serve the army by endowing the youth entrusted to its care with a sound mind in a sound body, and a soul fitted with patriotism; and the army, regarded as an institution of the State, may serve the cause of universal instruction in two direct ways:—(1) By the instruction and perfection of elementary knowledge, that is to say, by repairing and completing popular instruction; and (2) by the foundation and maintenance of its own institutions of education, which partly form the continuation of the elementary schools, or which undertake the complete instruction of their scholars. Moreover, the army, which does not cease to complete the instruction of all its members, whatever be their functions, renders an indirect service to the intellectual movement of a whole population.

The following is a *résumé* of the second report, by **M. Tempels**, military auditor, Brussels:—(1) All work of the elementary school, developing physical, intellectual, and moral forces, directly profits the army; (2) a virile organisation of adult schools should include a certain military education; (3) the army should be a school, producing both military and general instruction; (4) the system of substitutes is an obstacle which justice and public interest should suppress; (5) military penal law should inspire the necessity of eliminating unworthy members; (6) normalists should not be exempt from the militia; (7) it would be advisable to prepare the normalists to be non-commissioned officers.

The discussion, under the presidency of **M. Van Damme**, Governor of Luxemburg, was begun by

M. Jean Macé (Paris), who remarked that, in France, gymnastic or military education began in the infant schools. Adult schools had not succeeded, because they were badly organised. He recommended the formation of temporary and obligatory adult schools, which would be attended for a month; the year's voluntary service would then come like a national university after the month's school.

M. Francolin desired to see the suppression of armies, and an accession to the ranks of elementary instructors.

School Hygiene.

The sixth Section, of which **Dr. Crocq** was president, and **Messieurs G. Washer** and **E. Janssens** were vice-presidents, was the only one which did not submit a question for discussion in general assembly. The programme comprised six questions, reports as to which were contributed by hygienists in England, France, Belgium, Holland, Hungary, Russia, and Switzerland.

The lighting of schools by day, which was the subject of three reports, gave rise to the following expression of opinion:—"In principle, the class-rooms should be lighted during the day by bays on one side and to the left of the pupils, so arranged that all the places be fully and equally lighted, independently of ventilation."

The question of the dimensions of school-rooms was the subject of the following note:—"The length of a class-room for 50 pupils (the maximum) should be 9·6 m., and the breadth from 6·6 m. to 8 metres." In an exhaustive report on this subject, J. B. François de Chaumont, M.D., F.R.S., professor of hygiene at the Military School of Medicine, Netley, states that the height should not be less than 4 m., nor more than 4½ m., as in the latter case there is a disagreeable resonance.

The sanitary conditions of the yards, gymnasia, lavatories, &c., and the difficult question of ventilation in summer, and ventilation, combined with warming, in winter, formed the subject of reports by Dr. E. R. Perrin, of Paris; M. Wason, engineer, Paris; and M. Dekeyser, architect, Brussels.

The question of the best school furniture (masters' and pupils' desks, black-boards, &c.), from a hygienic point of view, was introduced by reports from Dr. Guillaume, vice-president of the Neuchâtel Health Committee, and by General Kokhowsky, president of the Pedagogic Museum of St. Petersburg. The Section unanimously approved of the single-place desks already employed in many schools on the Continent.

The third question, "How should kinder-garten be established and worked?" gave rise to two reports, both by ladies, the conclusions of which were generally adopted. That by Mdlle. C. Progler, of Geneva, illustrated by plans and sections, and details of furniture, recommended the twelve pictures of Dr. Kehr, of Halberstadt, the pictures for exercising the eyes by Mme. Pape Carpentier, and Prof. Sonnenschein's tables of numbers. That by Mdlle. L. Hardenberg supplements a report on the same subject, made to the Dutch Government in 1878, and is also illustrated by drawings.

The subject, "How should the medical service in schools be organised, as regards the hygiene of the building, the health of the pupils, and public health?" was introduced by a report by Dr. E. Janssens, Health Inspector for Brussels, which ended with the wish that all the States of Europe and America should follow the example of the Municipalities of Paris and Brussels in appointing medical inspectors of schools.

Dr. Bertillon, of Paris, and Herr Kôrôsi, Director of the Communal Office of Statistics, Buda-Pesth, submitted reports as to the "Statistical researches to be prescribed for ascertaining the influence of the school on the physical development of the child. Ultimately, the following wishes were expressed:—"1. That the Belgian Government take the initiative in establishing throughout the country, after the example of what has been done in Brussels, a table of hygienic statistics for establishing the influence of public schools on the health of the children. 2. That the new organisation of the medical Commissions in Belgium, and especially the creation of correspondents of these Commissions, become the starting point of continued researches into the hygiene statistics of the schools. 3. That a permanent exchange be made of health documents and information between the different countries."

At its last meeting, on 28th August, this Section was engaged with the question, "What practical measures should be enjoined in kinder-garten and primary schools, as regards (*a*) preventive medication, and (*b*) alimentation." Dr. Bonmariage, member of the Brussels Bureau of Hygiene, had prepared a report on the subject, dealing with the school, its physician, clothing, personal cleanliness, exercise, class hours, and the various articles of food suitable for children, which was sanctioned after a discussion between the author and Messieurs Absil, Créteur, and Lemercier on the question whether it is preferable to feed school children on feculent or nitrogenised substances. The majority of the meeting appeared favourable to the last method of alimentation; and the speakers advocated the administering of cod-liver oil and Polli's zootrophic powder to ailing children.

The closing *séance* was presided over by **M. de Selys-Longchamps**, who thanked the foreigners for having come to add weight to the proceedings.

During the week of meeting, the School Museum of the State, in the Rue Ducale, was opened by the Minister of Public Instruction, M. Van Humbeeck. Its nucleus was formed by the collection of school furniture and appliances sent to the Paris Exhibition of 1878, which obtained a gold medal. The collection has been added to by several objects from foreign countries.

ELECTRICITY IN COLLIERIES.

The following letter from Mr. W. H. Preece, has lately appeared in the *Times*:—

Sir,—Several correspondents recently advocated in the *Times* the employment of electricity for illumination in collieries. One suggests that portable lamps made of a battery and a vacuum tube should be employed. Such lamps have been tried frequently, but they have failed from want of permanence in the current and of intensity in the light. I have seen excellent lamps of this form, notably one made by Breguet, of Paris; but they proved much too feeble in illuminating power in practice. Others propose the use of the electric light on the assumption that such a light is safe. It cannot be too strongly insisted that the absolute safety of the electric light is a popular delusion. In the first place, the arc itself is the greatest source of heat which science possesses, and, in the second place, the wires conveying the electric currents that produce the arc may themselves be conveying energy in a form as insecure as a train of gunpowder. The danger of the electric arc is supposed to be removed by its insertion *in vacuo* in hermetically-sealed glass bulbs; but what if these bulbs be broken, and what about the difficulty in maintaining the vacuum?

Granting, however, that it be practicable to immure the light in a secure transparent vessel, what about the wires? The currents employed to generate the light are extremely powerful, in some cases many thousand times stronger than those employed to work telegraphs. Not long ago a poor musician in a theatre in Birmingham, and quite recently a Russian sailor on board the *Lividia*, were killed by incautiously seizing upon certain exposed parts of the conductors conveying these currents. The difficulty in maintaining currents in their proper path in telegraphy is very considerable. How much more difficult must it be to maintain those employed for electric lighting! Copper wires are carefully enclosed in india-rubber or gutta-percha coatings, but these insulating coatings are liable to injury; they are inflammable, and if a mere crack or pin-hole were to occur in such a coating, the currents would escape to earth, generating heat and producing fire. This view is not chimerical. Offices have been set on fire even by the currents employed in telegraphy. I know of two such cases; one in New York, and the other in Boston. It is not at all unlikely that the recent fire at Manchester arose from such a cause. The liability to such accidents is evidently much greater with electric lighting, and it is only technical knowledge and professional skill which can render such currents innocuous even in well-constructed buildings. In mines, however, the difficulty is much greater. There the wires must necessarily be suspended in narrow, frequented galleries close to the damp earth, and be liable to incessant injury, and they could be rendered comparatively safe only by costly cabling. It would be impossible to guarantee absolute security. To light a colliery by electricity would therefore be both costly and dangerous. The popular delusion as to the safety of the electric light is probably due to its being so frequently spoken of as a cold light, the word 'cold' being used in its figurative sense of cheerless, the unscientific taking the word in its literal sense.

There is reason to believe that electricity plays another important part in colliery accidents. Some months ago there was a terrible disaster in the Risca colliery in South Wales; over 70 human beings were hurried into eternity. An inquiry was held into the cause of the disaster, and the conclusion arrived at was very unsatisfactory. A well-known telegraph engineer, Mr. Arthur Radcliffe, from evidence collected on the spot, arrived at the conclusion that the mine was discharged by a flash of lightning. He submitted his evidence to me, and I fully concurred with him. All the conditions of such a catastrophe were present. The flash of lightning was seen to strike the head-gear of the shaft immediately before the explosion. This machinery was connected with the bottom of the shaft by several continuous conducting masses. Iron-rails, resting on poorly-conducting matter, extended thence throughout the galleries. The gas was there, and it only wanted a break of continuity in the metallic masses conveying electricity, of which there were many, to produce sufficient heat to fire the charge. I have no doubt that lightning was the cause of the explosion. These facts wers submitted to those who were concerned in the inquiry; but, probably, being incomprehensible to them, they were ridiculed and therefore ignored.

Hence I advocate the employment of well-constructed lightning conductors over the head-gear of shafts to keep electricity out of the colliery and to insure safety, rather than the erection of conductors along its galleries to convey it in them for purposes of illumination and to court danger. (Signed)

W. H. Preece, President of the Society of Telegraphic Engineers.

NOTES ON SOME NEGLECTED FIBRES.

By C. G. Warnford Lock.

While attention is deservedly bestowed upon the introduction of well-known fibre-plants, such as cotton, into new spheres of growth, there is, perhaps, too little disposition to search out and make the most of the fibrous qualities of other plants, found flourishing in a wild state in many parts of the world.

Those who have studied the subject, as several distinguished members of the Society of Arts have done, are aware of the profusion of plants whose fibres are utilised more or less by the natives of the lands where they grow, and which might be made to serve the pressing needs of civilised countries for textiles, ropes, and especially paper.

Most useful work has been done by Dr. Hermann Grothe, of Berlin, in making the humbler fibre-plants more generally known, in a little pamphlet embodying his observations on the vegetable fibres shown at the exhibitions held in London, St. Petersburg, Naples, Copenhagen, Amsterdam, Moscow, Milan, Vienna, Philadelphia, Paris, &c. Mainly from this pamphlet, the following notes have been condensed:—

Seed-hairs.

In this section, the *Bombax* species is one of the most important, including *B. Ceiba*, *B. heptaphyllum*, *B. malabaricum*, *B. hibiscifolium* (Venezuela), *B. munguba*, *B. carolinum*, and *B. pentandrum*. In Java, the capsules of *B. Ceiba* are gathered, and the seed-hairs are employed in stuffing and textiles, while the seeds are pressed for their oil. Similar use is made of the other species in Japan, Brazil, Guiana, Bourbon, Nicaragua, Venezuela, &c., under the local names, "édredon végétale," "patte de lièvre," "paina limpa," "barrigada," "soie de fromager," "gatillo," "pluma samauma," "ouate végétale." Closely allied are the seed-hairs of *Ochroma Lagopus*, *Eriodendron gossypium*, *E. caribæum* (Cuba and Porto Rico), *E. samauma* (on the Amazon), *E. anfractuosum* (Portuguese Africa), and *Chorisia speciosa*, and *C. crispifolia* (especially in Brazil); *Stephanotis*, *Ganolobus*, and *Fischeria* (in Brazil); also *Calotropis gigantea*, *C. Cornuti* (Senegal), *Strophanthus*, *Pladera*, *Pachira princeps*, *Rupellia*, *Ichnocarpus*, *Sterculia caribæa*, *Echites*, *Morrenia brachystephana* ("tasi," in the Argentine Republic); *Cochlospermum gossypium* (E. Indies), *Beaumontia*, *Orthanthera*, *Apocynum*, *Epilobium*, *Eriophoron*, *Typha angustifolia*, *T. latifolia* ("masette"), *Zamia spiralis* ("dwarf palm"), and *Celmisia coriacea*. These fibres bear, in many respects, close resemblance to the most important and valuable

of their class—the common cotton; but their shortness is a drawback to their being spun, and their softness and poverty are opposed to their use in paper-making. In Amsterdam, considerable quantities, imported from Java and the Sunda Islands, are employed for stuffing pillows, cushions, and mattresses.

Fibres of Leaf-ribs, Roots, Fruits, &c.

Liliaceæ.—At the Cape of Good Hope, *Tritoma uvaria* and *T. recurvata* are utilised as fibre-plants. The leaves are crushed, and treated in boiling water; the fibres separate in the course of a day. The plants have been grown in Victoria since 1876. The genus *Yucca* is indigenous to Mexico, Texas, Georgia, Florida, Central America, the W. Indies, and the E. Indies. The fibres of the species *Y. gloriosa*, *Y. aloefolia*, *Y. pendula* (Algiers), *Y. angustifolia*, and *Y. filamentosa* are utilised, and pass by the name of "petre hemp." *Y. acaulis* gives a fibre called "maguey de cocuy" in Venezuela. *Dracæna draco* (W. Africa and the Canaries) affords a strong fibre. More widely used are the fibres of *Sanseviera*, called "marove" and "marool" in the E. Indies, "moorva" in Java, "Cingalese hemp" and "bowstring hemp" in Ceylon and India, "African hemp" in Guinea and Tropical Africa. The species *S. lanuginosa*, *S. cylindrica*, and *S. zeylanica* are indigenous to the E. Indies, and grow, in the Balasore district, as well inland as on the coast. They prefer low, moist, shady, and even stony places. The leaves are about 3 ft. long, and each gives 30—40 bundles of fibre. The preparation is very primitive, and the product has no place in commerce. In Africa, besides the above species, occur *S. fasciata* and *S. guineensis*; *S. angolensis* (Portuguese Africa) gives an "African hemp;" *S. longifolia* also occurs, but never in the neighbourhood of *S. angolensis*. *Astelia Banksii* and *A. Cunninghamii* (New Zealand, India, and Angola), furnish leaves respectively 4 ft. and 4 ft. 9 in. long, containing long and fine fibres, extracted by retting. *Cordyline australis* is cultivated for its fibrous leaves, which are macerated and digested. *C. indivisa* is said to furnish the "toi" of the Maories; the leaves are 3 ft. to 4 ft. 6 in. long, and about 2 in. wide. Somewhat superior is the fibre of *C. pumilio*, the "tirauriki" of the New Zealanders, which is very long and strong. The species *C. stricta*, *C. terminalis*, *C. cannæfolia*, *C. robusta*, and *C. nutans* also contribute fibres, bearing a close resemblance to phormium fibre. They are found also in Australia, China, India, the South Sea Islands, Norfolk Island, &c. The fibres of *Dianella elegans*, *D. tasmanica*, *D. cærulea*, *D. longifolia*, *D. bambusacea*, and *D. revoluta* appear to be of great value; they are 12—20 in. long, very strong, and silky.

Iridaceæ.—*Iris* (*Moræa*) *Robinsonia* (New South Wales) affords leaves 5 ft. long, from which a fibre is obtained by retting.

Amaryllidæ.—Perhaps the most important members of this family are the *Agave* and *Aloe* genera, which are very commonly confounded. The leaves of *Agave americana* (Mexico, Central America, and Venezuela) afford the natives, by retting, a fibre called "ixtle," of great strength and utility. In India, occur *A. sisalana*, *A. indica*, and *A. vivipara*, and produce "Sisal," or "grass hemp." In Africa, *Aletris guineensis*, and in Java and India, *A. cantula*, are utilised. There also, and in Algiers, Spain, Mexico, Central America, &c., grows *Agave fœtida* (*Fourcroya gigantea*), the tallest species, attaining a height of 45—50 ft. in Mexico, and up to 60 ft. in Algiers. In Venezuela, especially in the province of Barquisimeto, the fibre, called "cocuiza," is used for making sacks. The plant has been introduced into Cuba, Hayti, Florida, Texas, and even Europe, and its fibre has received the names of "white hemp" in Hayti, "Cuba hemp," "aloe hemp," "pita hemp." At the Philadelphia Exhibition of 1876, *Agave americana* fibre was shown from Texas, Mexico, Guatemala, Nicaragua, Venezuela, Jamaica, the Cape, Mauritius, Morocco, the E. Indies, &c. In Victoria, flourish *A. americana* and *F. gigantea*. There also, and in Queensland, occur *Doryanthes excelsa* and *D. Palmeri*, whose fibres are often confounded with that of *Fourcroya*. The fibre of a *Fourcroya* growing in Brazil is beautifully white, silky, and 3 ft. long, but weak. A fibre is extracted from *Aloe ferox* in Natal. *A. vulgaris* and *A. succotrina*, abundant in S. Europe, Asia Minor, and S. Africa, give, in the Zambesi country, the "konge" fibre of the natives.

Bromeliaceæ.—The two most important genera are *Bromelia* and *Ananassa*. The wild pineapple, under various names, the most recent of which is *Ananassa sativa*, occurs in immense quantities in N. and S. America, Mexico, Africa, India, Java, &c. The leaves afford 25—40 per cent. of fibre, which, in America alone, must amount to at least 1,200 tons annually, now wasted. *Bromelia* (now *Nidularium*) *karatas*, *B. pita*, *B. pinguin*, *B. pigna*, *B. sativa*, and *B. sagenaria*, all very closely alike (some probably identical), are found in the W. Indies, Central America, Brazil, the E Indies, Philippines, &c. Some of the most common names of the fibre are "silk-grass," "Peru hemp" (also given to *Buonapartea juncea* in Peru), "sinamai," "pina," "tallinanas," "gravatha" (also given to *Bilbergia tinctoria* in Brazil), "carana."

The climber *Tillandsia usneoides* grows abundantly in Florida, Georgia, Louisiana Texas, Central America, Guiana, Brazil, and the Argentine Republic. It is exported in large quantities from New Orleans, as a substitute for horse-hair in stuffing. The various names are "barba di velho," "caragate," "barbe espagnole," "Delta moss," "Spanish moss," "New Orleans moss."

Musaceæ.—Foremost is the genus *Musa*, of which one species, *M. textilis*, affords the well-known Manilla hemp, locally called "abacá," "oetan," "koffo," "pisangbatoe," "soetan," "lupis," "merado koffo." It is cultivated only in the Philippines. Other species possessing useful fibres, but not turned to any account, are *M. paradisiaca*, *M. ensete*, *M. sapientum*, *M. Banksii* (in Queensland), *M. mindanensis*, *M. Cavendishi*, *M. basho* (utilised in Japan), *M. Rumphiana* (Java), *M. violacea* (Angola), *M. discolor*, *M. rosacea*, *M. ornata*, *M. troglodytarum*.

The genus *Heliconia* (Antilles) and *Strelitzia juncea* (Africa) are utilised as fibre plants. The long leaves of *Walwitschia mirabilis* (Angola and Benguela) furnish a textile fibre. *Canna indica*, *C. discolor*, *C. heliconiæfolia*, *C. macrophylla*, *C. Warczewieczii* are useful for paper-making.

Palmaceæ.—The principal fibre-yielding palms are:—*Caryota urens*, "kittool" (India and Ceylon), *C. mitis* (Réunion), *C. onusta* (Philippines); *Corypha australis*, *C. taliera*, *C. elata* (Australia and E. Indies), *C. gebanga* (Java, India, &c.), *C. umbraculifera* (Java, India, and the Philippines), *C. mitis* (Ceylon), *C. latania* (Java and India), *C. horrida* (Ceylon); *Livistona humilis* and *L. inermis* (Australia); *Arenga saccharifera*, "gomuti" (Java, Siam, China, Cochin China, and W. Africa); *Raphia vinifera* and *R. Ruffia* (Madagascar), *R. angolensis* (W. Africa); *Carludovica palmata* (Brazil, Colombia); *Mauritia flexuosa* (Brazil, Guiana, Colombia, and Asia), *M. vinifera* (Brazil); *Borassus flabelliformis* (India, Ceylon, Sunda Islands); *Attalea funifera*, "piassaba" (Brazil and Venezuela); *Leopoldinia Piassaba*, "piassaba" (Brazil and Venezuela); *Chamærops excelsa* and *C. humilis* (S. Europe, Algiers, Africa, China), *C. palmetto* (Louisiana and S. Carolina), *C. hystrix* (Central America); *Astrocaryum vulgare* and *A. Ayri* (Brazil); *Manicaria saccifera* (Brazil); *Momordica operculata* (Brazil); *Areca catechu* and *A. oleracea* (E. Indies and Sunda Islands); *Phœnix dactylifera* (S. Europe, N. Africa, Arabia, Syria, Persia, E. Indies), *P. acaulis* (Coromandel), and *P. sylvestris*; *Cocos nucifera*, "coir" (in all the tropics); *Thrinax argentea* (Cuba); *Celmisia coriacea* (Australia); *Lodoicea maldivica* (Seychelles); *Arrudaria* (*Corypha*) *cerifera* (Brazil); *Raphis flabelli-*

formis (Réunion); *Jubœa spectabilis* (Chili); *Hyphœa guineensis* (Angola), *H. crucifera* (Nubia); *Elœis guineensis* (W. Africa); *Nipa fruticans* (E. Indies); *Sabal mexicana* (Mexico); *Bactris setosa* (Brazil); *Platonia insignis* (Brazil); *Lecythis ollaria* and *L. grandiflora* (Brazil); *Acrocomia sclerocarpa* (Brazil); *Diplothenium Torallii* (Australia). The genus *Calamus* is usually placed among grasses. The most common species are *C. Rotan, C. rudentum, C. erectus. C. verus, C. gracilis, C. Draco, C. Royleanus, C. extensus, C. tenuis, C. scipionum.* This fibre has recently been turned to account for mat-making in this country, besides the old applications to chair-seats, window-blinds, &c.

Pandanaceæ.—The genus *Pandanus* includes *P. utilis, P. edulis, P. volubilis, P. candelabrum, P. odoratissimus, P. pedunculatus, P. spiralis.* They flourish in the E. Indies, S. America, &c. The natives of Mauritius, Bourbon, &c., prepare the fibre of *P. odoratissimus* with care, and obtain a fine soft material, called "vacoa," or "bakua" (in the E. Indies "budki"), for textiles, and a stronger material for sacking. The fibre is called "palungor" in India, "carapicho" in Brazil.

Xerotideæ.—*Xerotes longifolia*, a native of Queensland, with leaves 4—6 feet long, affords the aborigines a useful fibre, and is now largely employed for paper-making. Other species in Australia are *X. filiformis, X. tenuifolia, X. glauca, X. rigida.*

Juncaceæ.—*Juncus maritimus* and *J. vaginatus* (Australia) are utilised for paper-making; *J. acutus* (Italy) affords a cordage fibre; *J. effusus* (Spain), a textile fibre.

Gramineæ.—The principal use of the members of this family is for paper-making. The most important are *Macrochloa (Stipa) tenacissima* and *Lygeum spartum*, both found in Spain and N. Africa, and affording the well-known "esparto" of commerce. Much of that obtained from Algiers, Tunis, and Tripoli is the produce of *S. gigantea*, and *M. arenaria. S. Ichon* and *Chusquea Lorentziana* occur in the Argentine Republic, and *S. setacea, S. pubescens, S. micrantha* in Australia. *Andropogon involutum, A. glycichylum, A. saccharatum, A. Iwarancusum* (E. Indies), *A. condensatum* (Argentine Republic), *A. tenuis, A. sericeus, A. triticeus* (S. Australia), afford useful fibre; also *A. gryllus* and *A. Ischæmum* (Europe), and *Gymnostachys anceps* (New South Wales).

Saccharum Ravennæ and *S. Sorghum* are of small importance. *S. munja* (India, especially Oude) is cultivated, and affords the "moong" fibre for cordage and textiles. *Arundo saccharoides* (Venezuela) furnishes material for the "sombrero" hats; *A. ampelodesmos* (Italy) is used for cordage; it occurs in quantity in the Portofino range. *A. festicoïdes, Ampelodesmos tenax, Arundinaria macrosperba* (Mississippi), *Bambusa arundinaria, B. nigra, B. mitis, B. verticellata, Donax arundinaceus, Festuca patula, Hydropyrum esculentum, Zizania aquatica, Zostera marina*, &c., afford fibres.

Typhaceæ.—*Typha angustifolia* and *T. latifolia*, as well as *Sparganium latifolium*, have local applications (Spain, Egypt, Tunis, and Japan).

Cyperaceæ.—*Cyperus papyrus* (Egypt) and *C. rotundus* (Japan) are much used for basket-making. In Angola, papyrus leaves are used with baobab fibre for mats, &c. Others are *Carex apressa* and *C. tereticaulis, Cladium radula* (Tasmania), *Lepidosperma gladiata* and *L. elatia* (Australia); *Schœnus brevifolius* (coasts of S. Australia, Victoria, and Queensland) *Hydropirium latifolium* (Japan), *Isolepis barbata* and other species (Japan and Australia), *Scirpus maritimus, S. lacustris*, &c.

Filices.—The root-fibres of *Pteris aquilina* (Japan) are used for cordage. In Brazil and Cuba, *Polypodium calaguala* is utilised. In the Sandwich Islands, *Cibotium Barometz* affords the "pulu" fibre.

Coniferæ.—From the needles of *Pinus sylvestris* is made a textile fabric, in Thüringer-wald, America, England, France, Sweden, Holland, and Austria. In Japan, *Cryptomeria japonica, Chamæcyparis obtusa*, and *Pinus densiflorus*, are utilised for the production of lint.

Araliaceæ.—*Aralia papyrifera* and *Hedera helix* yield the Chinese "rice paper."

Bast fibres will be treated in the second part of these notes.

GENERAL NOTES.

Small Investments.—On and after the 22nd inst., any person will be able, in accordance with the terms of the Savings Bank Act of last Session, to invest at any savings bank post-office in the United Kingdom small sums in Consols, Reduced, or New Three per Cent. Stock. The sum so invested must not be less that £10, nor exceed £100 in any one year, and the agregate account held by any one investor must not exceed £300. This is a subject which long since received the attention of the Society of Arts. It was brought under their notice by Mr. Bartley. A deputation of the Society waited upon the Chancellor of the Exchequer in May, 1874, when Mr. Bartley explained his proprosal.

Sanitary Assurance Association.—A meeting was held on Monday, November 1st, at the "Langham" Hotel, to consider the desirability of forming a Sanitary Assurance Association "for the purpose of securing to its members, at a minimum cost, those advantages which the progress of sanitary science has made available." The chair was taken by Sir Joseph Fayrer, K.C.S.I. "It is intended that the association shall inspect and supervise houses of every class, and for this reason the subscription, constituting membership, has been fixed at half-a-guinea per annum, with an entrance fee of the same amount. This sum will entitle members to have placed, on the assurance register, one house not exceeding the yearly value of £40. For houses above the yearly value of £40, an extra fee will be charged, in accordance with the fixed graduated scale, and in all cases beyond the metropolitan area, members will be charged with travelling expenses." Prof. Corfield was appointed as Chief Sanitary Officer of the association, and Mr. Mark H. Judge, as surveyor, *pro tem.*

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 8th...Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Joseph Thomson, "Journey to the Lukuga Outlet of Tanganyika, *via* the north end of Lake Nyassa."

Tuesday, Nov. 9th...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Benjamin Walker, "Machinery for Steel-making, by the Bessemer and the Siemens Processes."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m.

Wednesday, Nov. 10th...Society of Telegraphic Engineers. 4, Broad Sanctuary, Westminster, 9 p.m. Opening of the Ronalds Library, and reception of the Members by the President.

Thursday, Nov. 11th...Mathematical, 22, Albemarle-street, W., 8 p.m. 1. The President, "Considerations Respecting the Translation of Series of Observations into Continuous Formulæ." 2. Mr. Hen. Jeffery, "Bicircular Qualities, with a Triple and Double Focus, and Three Single Foci, all of them Collinear." 3. Rev. C. Taylor, "Further Remarks on the Geometrical Method of Reversion."

Saturday, Nov. 13...Trades' Guild of Learning (at the House of the Society of Arts), 8 p.m. Lecture by Wm. Morris.

Physical, Science Schools, South Kensington, S.W., 3 p.m. 1. Mr. R. H. M. Bosanquet, "The Beats of Mistuned Consonances of the Form h : 1." 2. Profs. Ayrton and Perry, "Notes on Prof. Exner's paper on Contact Electricity." 3. Mr. Walter R. Browne, "Action at a Distance."

OURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, NOVEMBER 12, 1880.

ll communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ARRANGEMENTS FOR THE SESSION.

The first meeting of the One Hundred and wenty-seventh Session of the Society will be held n Wednesday, the 17th inst., when the Opening ddress will be delivered by F. J. BRAMWELL, .R.S., Chairman of the Council. Previous to hristmas, there will be four ordinary meetings, n addition to the opening meeting.

Candidates proposed for election as members are rivileged to attend the opening meeting.

ORDINARY MEETINGS.

The following arrangements for the Wednesday venings before Christmas have been made :—

NOVEMBER 17.—Opening Meeting of the Session. ddress by F. J. BRAMWELL, F.R.S., Chairman of the ouncil.

NOVEMBER 24.—"The Influence of Barry upon nglish Art." By J. COMYNS CARR.

DECEMBER 1.—"The Photophone." By W. H. REECE, Pres. Soc. Tel. Engineers.

DECEMBER 8.—"London Fogs." By Dr. ALFRED ARPENTER.

DECEMBER 15.—"The Use of Sound for Signals." y E. PRICE EDWARDS, Secretary to the Deputy-Master f the Trinity-house. On this evening Dr. TYNDALL, .R.S., will preside.

At the Meetings after Christmas, the following apers, among others, will be read :—

"Buying and Selling; its Nature and its Tools." y Prof. BONAMY PRICE. On this evening Lord ALFRED . CHURCHILL will preside.

"The Participation of Labour in the Profits of En- rprise." By SEDLEY TAYLOR, M.A., late Fellow of rinity College, Cambridge.

"The Gold Fields of India." By HYDE CLARKE.

"Flashing Signals for Lighthouses," By Sir WM. HOMSON, F.R.S.

"The Present Condition of the Art of Wood-carving n England." By J. HUNGERFORD POLLEN.

"Ten Years' Experience of the Working of the Trade lark Act." By E. C. JOHNSON.

"Trade Prospects." By STEPHEN BOURNE.

"The Manufacture of Aërated Waters." By T. . BRUCE WARREN.

"The Compound Air Engine." By Col. F. BEAU- ONT, R.E.

"Improvements in the Treatment of Esparto for the Manufacture of Paper." By WILLIAM ARNOT, F.C.S.

"Deep Sea Investigation, and the Apparatus used in it." By J. G. BUCHANAN, F.R.S.E., F.C.S.

"The Discrimination and Artistic Use of Precious Stones." By Prof. A. H. CHURCH, F.C.S.

"Indian Agriculture." By W. R. ROBERTSON.

"Trade Relations between Great Britain and her Dependencies." By WM. WESTGARTH.

"Causes of Success and Failure in Modern Gold Mining" By A. G. LOCK.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at Eight o'clock :—

February 1, 22; March 15; April 5; May 10, 31.

APPLIED CHEMISTRY AND PHYSICS SECTION.

The meetings of this Section will take place on the following Thursday Evenings, at Eight o'clock :—

January 27; February 24; March 24; April 7, 28; May 26.

INDIAN SECTION.

The meetings of this Section will take place on the following Friday Evenings, at Eight o'clock :—

January 21; February 11; March 4, 25; April 29; May 13.

CANTOR LECTURES.

The First Course will be on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Prof. A. H. CHURCH, M.A. Oxon., F.C.S. Five Lectures.

The Second Course will be on "Watchmaking," by EDWARD RIGG, M.A. Three Lectures.

The Third Course will be on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. ADAMS, F.R.S. Four Lectures.

The Fourth Course will be on "The Art of Lace-making," by ALAN S. COLE. Three Lectures.

The Fifth Course will be on "Colour Blindness and its Influence upon Various Industries," by R. BRUDENELL CARTER, F.R.C.S. Three Lectures.

Syllabus of the First Course.

LECTURE I.—NOVEMBER 22.—Bricks, tiles, terra-cotta, basalts, and unglazed earthenware in general.

LECTURE II.—NOVEMBER 29.—Vitreous, plumbiferous, boracic, and felspathic glazes and enamels. Iridescent and metallic lustres, and colouring substances.

LECTURE III.—DECEMBER 6.—Stoneware and other wares glazed with salt.

LECTURE IV.—DECEMBER 13.—Soft paste porcelains, European and Oriental.

LECTURE V.—DECEMBER 20.—Hard paste porcelains, Chinese, Japanese, and European.

JUVENILE LECTURES.

The usual short Course of Lectures adapted for a juvenile audience will be given by G. J. ROMANES, F.R.S., on "Animal Intelligence." The dates

for the lectures will be 29th December and 5th January. The lectures will commence at 7 o'clock. Special tickets will be issued for these lectures.

Admission to Meetings.

Members have the right of attending all the Society's meetings and lectures. They require no tickets (except for the Juvenile Lectures), but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

Annual General Meeting.

The Annual General Meeting will be held on June 29th, at four o'clock.

The following is a table of dates of the Evening Meetings of the Society, subject to such alteration as may be found necessary:—

	CANTOR LECTURES.	FOREIGN AND COLONIAL MEETINGS.	ORDINARY MEETINGS.	APPLIED CHEMISTRY AND PHYSICS MEETINGS.	INDIAN MEETINGS.
1880.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.
November	— — 22 29 —	— — — —	— — 17 24 —	— — — —	— — — —
December	6 13 20 — —	— — — —	1 8 15 — —	— — — —	— — — —
1881.					
January	— — — — —	— — — —	— 12 19 26 —	— — 27 —	— — 21 —
February	7 14 21 — —	1 — — 22	2 9 16 23 —	— — 24 —	— 11 — —
March	7 14 21 28 —	— 15 — —	2 9 16 23 30	— — 24 —	4 — 25 —
April	— — — 25 —	5 — — —	6 — — 27 —	7 — 28 —	— — 29 —
May	2 9 16 23 30	— 10 — 31	4 11 18 25 —	— — 26 —	— 13 — —

The Chair will be taken at Eight o'clock at each of the above Meetings.

MISCELLANEOUS.

NOTES ON SOME NEGLECTED FIBRES.

By C. G. Warnford Lock.

(*Continued from p.* 914.)

Bast-fibres.

Such well-known members of this class as flax, hemp, jute, China grass, &c., need no mention here.

Malvaceæ.—The fibres extracted from *Abutilon venosum*, *A. amplum*, *A. auritum*, *A. molle*, *A. striatum*, *A. indicum*, &c., are utilised in Africa, Brazil, Australia, and the East Indies. The stems are cut off, sun-dried, and retted in bundles for ten days. In Algeria, *A. indicum* is extensively cultivated. A more important genus is *Hibiscus*—*H. splendens*, *H. elatus*, *H. mutabilis*, *H. tiliaceus*, *H. zonatus*, *H. heterophyllus*, *H. syriacus*, *H. sabdariffa* (*roselle*), *H. cannabinus*. The fibres yielded by these plants are called, in India, "gambo," "pundi," "ambaree;" in Cuba, "majaqua;" in Angola, "ketmie," "punda;" in Queensland and New South Wales, "hollyhock fibre," "Batham hemp;" in Syria, "rose hemp;" elsewhere, "brown hemp," "roselle." It is widely believed in India that *H. cannabinus*, properly grown and retted, is superior in all respects to jute; large quantities of this fibre come into commerce as jute. In Victoria, *H. splendens* grows 9 to 21 feet high; in Japan, *H. syriacus* is cultivated and largely utilised.

In Spain, is utilised the unusually fine, strong, and white fibre of *Lavatera maritima*. The plant is perennial, and easily cultivated: it has lately been grown experimentally in Australia. *L. olbia* and *L. arborea*, both of S. America, growing best on the coast, yield fine fibres by retting. *Malva rotundifolia*, *M. crispa*, and *M. sylvestris* are widely utilised; also *M. peruviana* in Peru, and *M. mauritiana* in Italy, Portugal, Spain, &c. The fibres from *Plagianthus pulchellus* and *P. betulinus* are much esteemed in New Zealand, Tasmania, Victoria, and New South Wales. They are long, fine, and soft, and seem lately to have attracted as much attention as those from *Sida rhomboidea* and *S. retusa*, which are extracted and valued in the E. Indies, China, N. Australia, Queensland, and America. In China, *S. tiliæfolia* is cultivated, and its fibre is esteemed superior to hemp; in India, *S. rhomboidea* is similarly placed before jute, yet the culture of both species is much neglected. The genus *Sida* is most widely distributed in the tropics of N. Australia; in a lesser degree, in the south also. In the former locality, grow *S. corrugata*, *S. intricata*, *S virgata*, *S. petrophila*; in the latter, *S. retusa*, *S. cordifolia*, *S. spinosa*, *S. macropoda*, and *S. rhomboidea*. Under the title "Queensland hemp," these fibres are already utilised for spinning and paper-making.

Other malvaceous plants, yielding useful fibres, are *Alcea*, *Malvastrum*, *Fugosia*, *Thespesia*, *Althæa cannabina*, *Paradium elatum*, *Pueraria Thunbergiana*, *Lagunaria Patersoni* (Norfolk Island), *Echytes barriguda* (Brazil), and *Adansonia digitata*. The last-named affords a bark-fibre, which, in Angola, Loando, and Inner Africa, is employed for lines and nets, and is shipped from the Congo, to the extent of about 1,700 tons yearly, chiefly for paper-making.

Tiliaceæ.—Several members of this family produce a useful bast. *Tilia pauciflora*, *T. parviflora*, *T. vulgaris*, *T. platyfolia*, and *T. angustifolia*, are utilised in Europe, the Caucasus, and Central Asia, more particularly in E. Russia, and *T. cordata* in Japan; also *Elæocarpus cyaneus* and *E. obovatus*, in Australia. The preparation of the bast is not difficult. It is stripped from the young trees in spring, retted for several months (generally in stagnant water), washed clean, and dried. Both in Russia and Japan, it is largely applied to numerous purposes—baskets, hats, ornaments, and especially shoes—while it is elsewhere widely consumed for binding. It is estimated that 30,000,000 young linden trees (5—10 years old) yearly are robbed of their bast. In the governments of Nijni Novgorod, Wiatka, Kostroma, and Minsk, the manufacture of linden-bast shoes numbers 7,000,000 pair. Besides this, about 400,000 pieces of matting are exported through Archangel, and at

least 1½ millions at the Black Sea ports and landwise, while the internal consumption much exceeds the export. In Japan, the bast is prepared much finer, and extensively manufactured into textiles. *Sparmannia africana* ("African hemp"), by retting, yields a fibre that is largely used locally; it is now introduced into Australia. *Grewia occidentalis* ("Kaffir hemp") affords a white fibre, of great strength, which is extracted by the Kaffirs of South Africa by retting, and is much used by them. The fibres of *Triumfetta appendiculata*, *T. glaucescens*, and *T. eliptica* (Brazil and Australia), and of *Aristotelia Magni* (South Sea Islands), are also somewhat extensively used.

Sapindaceæ.—The birch and alder contribute to the Russian bast industry, especially the former, some 16 millions young birch trees being deprived of their bark in a year. The bast of several species of chestnut (*Æsculus*) is similarly turned to account, large quantities being used in Brazil for caulking ships.

Sterculiaceæ.—*Sterculia fœtida*, *S. rupestris*, *S. Dombeya*, *S. acerifolia*, *S. ramiflora*, and *S. villosa*, indigenous to Australia, the E. Indies, America, and Natal, as well as *S. tomentosa* in Angola, afford excellent fibres. The wood of some species, *e.g.*, *S. acerifolia*, is so fibrous as to be useless as timber. *S. caribœa* (Trinidad and New Caledonia) affords a very fine fibre ("matagua"), which is much used; its seed-hairs are also employed.

Helicteres Isora, in the E. Indies, Japan, and Australia, affords a useful fibre ("muroor phalii"); likewise *Eriochlæna Candollii* (Brazil), *Lasiopetalum discolor*, and other species. *Melochia corchorifolia* (Australia), *Waltheria americana* (Brazil), and *Thomasia petalocalyx* (Australia and Africa). This family also includes *Hoheria populnea* (New Zealand), whose strong gauze-like bark fibre has long been utilised by the natives.

Thymelaceæ.—*Gnidia daphnöides*, *Daïs cotonifolia*, and *D. madagascariensis* (Africa, especially Madagascar), are rich in fibre. *Daphne cholua*, *D. cannabina*, and *D. papyrifera* are much employed in Nepaul and China. *Lagetta lintearia* (*Daphne lagetto*), occurring in Brazil and Jamacia, yields a mass of reticulated fibres ("lace bark"), which is converted into many fancy articles. *Daphne aureola* is utilised in Spain, where it is very common. From *Lasiosyphon speciosus*, is obtained the "rameta-bast" of India. *Dirka palustris* is found in N. America. Of the genus *Pimelea*, twelve species are natives of Australia; *P. axiflora* affords the "curra-jong" fibre of Victoria. *Passerina Gauppii* (E. Indies) also yields good fibre.

Anonnaceæ.—The fibre of *Xylopia frutescens* and *X. sericea* (Brazil), whose fruits form a kind of pepper, is locally employed for cordage; it appears in commerce as "pindayba." *Anona squamosa* is utilised in Guadaloupe and Angola.

Asclepiadaceæ.—Textile fibres are procured especially from *Asclepias astmatica* and *A. spinosa*; also from *Calotropis gigantea*, already noticed as yielding seed-hairs. This last is a native of India, and gives the fibre called "mudar" or "yercum." The plant is cultivated; cut down and sun-dried, the stems yield their fibre, which soon bleaches well in the dew. In the Amritsur district, also occur *C. procera* and another species. Useful fibres are likewise extracted from *Leptadenia*, *Orthanthera*, *Stephanotis*, *Beaumontia*, *Hoya*, *Periploca*, *Hemidesmos*, *Cynanchum*, *Vincetoxicum*, and *Marsdenia* (India, Senegal, N. America, Brazil, &c.). The *Marsdenia* fibre is termed "jetee," and is largely used.

Apocynaceæ.—The fibres of this family were formerly much more widely economised than they are at present. *Apocynum venetum*, *A. sibiricum*, *A. syriacum*, *A. fœtidum*, and *A. cannabinum* grow in great profusion in S. Siberia and Turkestan, also in Krim, Trans-Caucasia, on the Adriatic, in N. America, and in Panama. In Turkestan, *A. venetum* attains a gigantic stature; it occurs abundantly in the province of Semiretschi, in the lands of the Ili, on the banks of the Syr, throughout the khanate of Kokan, in the valley of the Zariadschane, and around the Aral Sea. In the lands of the Ili, the plant covers the steppes, and its fibre, under the name of "ema," is used for nets, fishing-lines, rope, and twine, but not for textiles. In other districts, the fibre is called "kendyr," and is more carefully prepared for textiles, in spite of the competition offered by cotton. The fibre is separated from the stems by a short retting; it is very strong and elastic, easily divisible, bleaches and dyes well, and occurs in such valuable lengths as 6—12 feet. Systematic cultivation of the plant is being set on foot in Turkestan and Senegal. In N. America, the fibre, called "wild silk-hemp," is employed by the natives, but has not yet received much attention from cultivators. In Germany, *A. cannabinum* is widely distributed. Other members of the family yielding fibres are *Aspidosperma* and *Hancornia* (Brazil), *Parsonia*, *Alyxia*, *Alstonia*, *Wrightia*, *Carissa*, *Nerium* (India), *Tabernæmontana dichotoma*, *T. orientalis*, *T. pubescens* (Australia).

Urticaceæ.—This family is conspicuous for the importance of its fibre-yielding members, among which are hemp and China-grass. It is estimated that from the mulberry trees (*Morus*) in the French silk districts, 15 million kilos, of fibre might be produced annually. The Japanese already utilise the fibre largely for paper-making. *Broussonetia papyrifera* ("paper-mulberry" or "kodzu,") is also used for paper-making in Japan, alone or together with *Chamæcyparis obtusa* ("hinoki"), *Passerina Gapuii*, *Edgeworthia papyrifera*, *Pikrasma ailanthoides*, *Lespedezza cystobotria* ("hanzi"), *Salix japonica* ("kawayanagi"), which are also converted into textiles. From several species of *Urostygma*, the bast fibres, "wad," "pimpal," "kel," &c., are extracted in the E. Indies. The fibres of *Gnetum funiculare* and *G. gnemon* have long been utilised by the Malays of the Sunda Islands. *Holoptelea integrifolia* (E. Indies), affords "wawla-bast." *Ficus indica* ("bar"), *F. retusa*, *F. aspera*, and *F. leucotricha*, are made use of in India. The fibres of *Planera japonica* and *Ulmus campestris* are extracted in Russia, China, and Japan.

The nettles form a very important group. The species hitherto identified are:—*Urtica* (*Bœhmeria*) *nivea*, *U.* (*B.*) *tenacissima*, *U. caracassana* (Tahiti), *U. crenulata* (India), *U.* (*Girardinia*) *heterophylla* (E. Indies), *U. argentea* (E. Indies, Sunda Islands, and Society Islands), *U. baccifera* (Cuba), *U. japonica* and *U. Thunbergiana* (Japan and the Sunda Islands), *U. alienata* (India), *U. dioica* and *U. urens* (Europe), *U. cannabina* (Caucasus, Turkestan, Siberia, and E. Indies), *U. virolenta* (India), *U. incisa* (S. Australia and Victoria), *U. æstuans* (Tahiti), *Bœhmeria candata* (Argentine Republic), *B. goglido* (India), *B. salicifolia* (India), *B. frutescens* (Naples), *B. diversifolia* (Sunda Islands), *B. puya* (India), *B. macrostachya* (India), *B. candicans* (Algiers and India), *B. sanguinea* (Java and India), *B. palmata*, *Laportea gigas* (New South Wales and Queensland), *L. pustulata* (N. America, Cuba, and Mexico), *L. canadensis* (N. America).

Urtica (*Bœhmeria*) *nivea* affords the bulk of the fibre now obtained from the nettles, and known as "China-grass," "ramie," or "rheea." The quality varies exceedingly with the methods of growth and preparation; the fibre brought from the Sunda Islands, India, Formosa, Siam, &c., is not so fine as that from the Chinese nettle-fields. *U. heterophylla* contains a very delicate, fine, and strong fibre, the plant thrives on the Neilgherries, and its cultivation has been commenced in Coimbatore. *L. pustulata* grows in the Alleghany range, and on the Mexican plateau abundantly, but as a branchy shrub; cultivated, it forms single stems, containing a fine fibre. *U. dioica* grows wild in Europe, but branchy; cultivated at 5—8 in. apart, the plants from single stems 4½—7½ ft. high. *L. gigas*, in Queensland and New South Wales, grows 70—80 ft. high on fen-lands, and gives branches 18 ft. long. The natives employ the fibre for nets, mats, &c.

The profitable extraction of fibre from nettles is pos

sible only when they are cultivated. The beauty, length, and strength of the fibres recommend them to all interested. In N. Europe, *U. dioica*, *U. urens*, and *U. cannabina* are grown; in France, Italy, Spain, and Portugal, *U. nivea* and *U. tenacissima*. In Algeria, *U. nivea*, *B. candicans*, *B. palmata*, and *B. tenacissima* give several crops annually. In N. America, *U. nivea* and *L. pustulata* are grown; the plantations in Louisiana and Mississippi have given three to four crops annually, an acre affording about 500 lbs. of fibre. In Australia, experiments are being made with *U. nivea* and *U. tenacissima*, the native *U. incisa* being unprofitable. In other of our colonies, the culture is being attempted, as in Jamaica, also in the Seychelles, Lagos, &c. The French colony of Cochin China produces much wild ramie, and the Government in Saigon is encouraging improvements in the culture and manipulation of the plant. Madagascar grows an abundance of nettles, and the French are endeavouring to start their cultivation in St. Mary's. Similar steps are being taken in Réunion, Senegal, Guadaloupe, and Guiana.

Sponia Wightii and *S. orientalis* are utilised in Venezuela and Mauritius; *Parietaria debilis*, in Portugal, Angola, and Australia; *P. malaisia*, in Sunda Islands; *Celtis philippinensis*, in the Philippines; *C. aspera* ("mukunoki") and *C. sinensis* ("yeoki"), in Japan; *C. trema* in Amboyna and Australia; *Fatoua pilosa*, in S. Australia; *Leucosnide candidissima* and *L. alba*, in Java. *Pipturus velutinus* (New Caledonia) affords a very beautiful fibre for fancy textiles; *P. argenteus* ("konganga" or "Queensland grass-cloth plant") occurs in N. America, the E. Indies, the Sunda Islands, N. Australia, and Queensland.

The fibre yielded by the hop (*Humulus Lupulus*) seems likely to receive some attention, especially in America. It is reckoned that the hop-gardens of America occupy some 24,000 hectares, and that the quantity of fibre contained in the plants is equal to two-thirds the yield of hops, or say 332 kilos. an acre, giving a total of $16\frac{1}{2}$ million kilos. At this rate, Germany, Great Britain, and Austro-Hungary might utilise about $46\frac{1}{2}$ million kilos. of hop fibre.

Leguminosæ.—The European genera, *Genista*, *Spartium*, *Ononis*, and *Cytisus* were formerly much more commonly employed than they now are. One of the most important is *Spartium junceum* ("Spanish broom"), and the two other species, *S. monospermum* and *S. multiflorum*. These occur in France, Spain, Portugal, Italy, Greece, and Turkey; they are found in great abundance in the Appennines and the mountains of Calabria, and in Tuscany, where the industry in "tela ginestrina" is becoming important. In Central France, the peasants still employ *Spartium* fibre for textiles.

Melilotus and *Astragalus* are other European fibre-plants. *A. confertus* is largely utilised in Thibet. *Lupinus albus* is also rich in fibre.

Dolichos trilobus is a most important fibre-plant in China, textiles made from it being termed "grass-cloth," like those from nettle-fibre. *Dolichos* or *Pachyrrhizus* fibre has been utilised in China from the earliest times; and in Shantung, the manufacture was so extensive that the tributes were paid in textiles made from it. *Muncana brasiliensis* seems to afford an equally valuable fibre. From *Dolichos umbellatus*, widely grown in Japan, no fibre is separated; but *D. tuberosus* and *D. bulbosus* (in China) are turned to account. *Pachyrrhizus montana* (Venezuela and New Caledonia) yields a moderately strong fibre. A most important fibre-yielding plant of Japan is *Wisteria chinensis*; the bast is very largely employed for baskets, plaits, and fine hats, also for lace and clothing. Another plant extensively applied to the same purpose is *Pueraria Thunbergiana*, well-known for its starch ("kudzu").

Crotalaria juncea and *C. tenuifolia* have long been classed among India fibre-plants. In Australia, *C. dissutiflora*, *C. linifolia*, and *C. crispata* occur wild; *C. juncea* is cultivated in Queensland.

Bauhinia racemosa, *B. scandens*, *and B. Vahlii* are utilised in the E. Indies; *B. Hookeri* grows wild in S. Australia. The fibres of these species are coarse, and used only for cordage. *B. reticulata*, *B. parviflora*, *B. rufescens*, &c., are employed in Senegal and Angola; *B. splendens* ("bepico de cadena"), in Venezuela; and *B. coccinea*, in Cochin China.

Other leguminous plants affording fibre of economic value are:—*Sesbania grandiflora*. *S. aculeata*, and *S. ægyptiaca*, natives of the E. Indies, Java, and Australia; *Æschinomœne cannabina* gives the "dunsha hemp;" *Æ. paludosa* (*aspera*) is a large ingredient of "rice paper;" *Butea frondosa* (Moorshedabad) gives "pulas hemp;" *B. superba* (India), "dhak hemp;" and *B. parviflora*, "palshin fibre."

Here and there use is made of the fibres of *Erythrina*, *Hedysarum*, *Cassia*, *Agati*, *Vigna*, *Arylosia*, &c.

The bast-fibres of *Acacia alba* and *A. catechu* are used for nets; *Mimosa scandens* gives the "gogo" fibre of the Philippines; and *M. dealbata* is utilised in Réunion.

Euphorbiaceæ.—*Euphorbia Royleana* is turned to account in the E. Indies, and *E. australis* in Queensland. *Jatropha gossypifolia* (Venezuela), and *Securidaca longipedunculata* (Zambesi), afford flax-like fibres; *Kydia calycina* (Jamaica), a good strong fibre; *Tropæolum majus* (Ireland), a flax-like fibre; and *Rourea santaloides* (Ceylon), a coarse fibre.

Salicaceæ.—Fibres for nets are afforded by *Salix cordata* on the Peel's river (N. America), and by *S. arctica* on the Mackenzie. *S. japonica* occurs in Japan.

Myrtaceæ.—An important genus is *Melaleuca*; M. *Preissiana* (not *squarrosa*) has a layer of soft fibre outside its strong solid timber, much used by the Australian aborigines. *Eucalyptus obliqua* (*nervosa*) has a very fibrous bark, applied to many purposes in Tasmania, Victoria, and S. Australia; *E. fissilis* is less fibrous. In Brazil, *Curatari tauari* affords fibre; further, *Bertholetia excelsa*, *Lecythis lanceolata*, *L. Pisonis*, *L. coriacea*, and *L. angustifolia*, yield fibre for ropes and for caulking ships. *Careya arborea* (Australia and the E. Indies) gives the fibre called "kumbi" and "phouleta."

Artocarpeæ.—*Artocarpus integrifolia* (New Zealand, Polynesia, and New Guinea), as well as *A. incisa*, affords a useful fibre, much employed by the natives under the name of "ti." In Cuba, occurs *Lonchocarpus sericeus* ("guama," "guacacao"). *Antiaris saccidora* affords, in India, the so-called "jasund;" in Venezuela, it is termed "dog-tree," and furnishes the "marima" shirts of the natives. *Trophis aspera* yields strong fibres, as also does *Lepuranda saccidora*.

Compositæ.—In this family, are *Bidens tripartita* ("water-hemp"), and *B. bipinnata; Eupatorium cannabinum*, *Ptarmica vulgaris* ("wild hemp"), and *Andromachia igniaria*, from Quito; *Stephanotis*, *Gandlobus*, *Fischeria* (Brazil); *Ruppelia grata*, *Ichnocarpus paniculus*, &c.

Byttneriaceæ.—The fibre of *Theobroma Cacao* is well known, but little used. *Abroma augusta* (India and Assam) is the source of the "oolut" fibre. Others are *Dombeya umbellata*, *Microlœna spectabilis* (much utilised in Madagascar), *Aletris nemorosa* (Pondicherry), *Cascarilla alba* (Bahamas), and *Guazuma ulmifolia* (S. America).

The list may be concluded with the following less important genera and species belonging to various families:—*Pothos violacea; Macrozamia spiralis; Miconia milleflora; Lasiandra papyrus; Luffa cylindrica* (Brazil and Venezuela); *Wildenovia teres* and *Restio tectorum; Quibori branca, Q. amarello, Q. villio; Thuya orientalis; Stravadium Lagunaria; Envira americana; Orcodoxa unamo* (New Granada); *Gyrinops Walla* (Ceylon); *Tacca pinnatifica; Hermas gigantea* (in the Hottentot country); *Espeletia grandiflora* (New Granada).

CORRESPONDENCE.

TENURE AND PRODUCE OF LAND IN THE PROVINCE OF SMYRNA.

At this moment, when the Eastern Question is an all absorbing one in England, it may be of some interest to the numerous readers of the *Journal of the Society of Arts* to know the facility with which land is acquired in this country, and the remuneration for the capital laid out on it.

The province of Smyrna, otherwise Vilayet of Aïdin, is eminently a maritime province; its length of sea-coast is computed to be 250 miles, its depth inland averages about 100 miles, consequently the whole area is about 25,000 square miles, or nearly as large as Ireland.

The population of the province is computed to be one million, this will give us a density of 40 inhabitants to the square mile, which is the lowest number, as compared with any other maritime province of Turkey. About 90 per cent. of the rural population are Turks; they are sober, peaceful, and to some extent industrious.

As to the quality and fertility of the land, it is enough to cite the beautiful and celebrated valleys of the Meander, Hermus, and the Cayster, which are the three jewels of the province, crowned on each side by lofty chains of mountains, full of mineral wealth. Its climate, generally very healthy, is mild in the valleys, and pleasingly cool in the mountains. Tmolus is capped with snow all the year round. The plains, in addition to all the different species of corn, produce the valuable staples of cotton, madder roots (*Rubia tinctorum*), the poppy, hemp, sesamy, tobacco, liguorice (growing wild), &c. In fruits, we have both the European and Eastern varieties, but the staples consist of figs, the finest in the world; the various qualities of raisins, from the delicious Sultanine to the common black raisin, so extensively exported of late into France, both for the manufacture of wine and the distillation of spirits; and last, but not least, the olive. In the highlands, in addition to corn and fruits, the staple produce is the vallonea (*Quercus aegilops*), of which not less than one million quintals or cwts. is exported annually from this place. Madder is driven out by the aniline dye process, described in the *Journal*.

Although the working of mines is yet in its infancy, still 30,000 quintals of emery stone is exported annually. Coal and lignite exist in many places, but are little worked, any more than the hematite iron ore and copper.

The value of landed property in and around cities is, as compared with the value of rural property, proportionately far higher than in any other country; this arises from various causes, first, from want of security; second, from the unlawful exactions on the part of tithe officials, to which the people are often subjected, when removed some distance from the centres of authority; and third, from the lack of any other safe investment of the savings of the urban population; hence, property in Smyrna will fetch about 3 per cent. per annum, while in the rural districts not less than 10 per cent. The land is measured here by doonooms (about one-fourth of an acre). The saleable value of land here, like anywhere else, depends on its quality, the hygienic state of the district, its vicinity to cities, and, above all, the density of population in its neighbourhood. The average price of arable land in well-populated districts is 30s. a doonoom, and in thinly populated parts it might be obtained for less than 5s. Vineyards from £2 10s., fig gardens from £4 to £20 a doonoom, olive groves are generally sold by the tree, from 5s. to £2 a tree. Of course, these prices are conventional.

Rural property in Turkey generally belongs to the Crown (*arazi mirié*), which is supposed to be the proprietor. Its sales are performed with the following provisos: — At every transfer a tax of 5 per cent. on the purchase money is levied by the Government, and its inheritance is limited to eight degrees of consanguinity: first, children of both sexes; second, grandchildren of both sexes; third, to father and mother; fourth, to brother and half-brother, by the same father; fifth, to sisters and half-sisters, by the same father; sixth, to brothers, by the same mother; seventh, to sisters, by the same mother; eighth, to the surviving husband and surviving wife. If no heirs, comprised in the above eight degrees of relationship, exist, the land returns to the Crown. After the acquisition of any such Crown lands, if the owner plants upon it a vineyard, vegetable garden, orchard, olive grove, or constructions of any kind built upon it, all such superficial property becomes freehold, and is, in consequence, inheritable by any distant relations. I am not going to enter in detail upon the intricacies of *vakufs*, Church property, of which there is but little in the rural districts. These are only inherited by the direct descendants of both sexes of the owner, there is also a fixed yearly perpetual money rent to be paid to the Church.

The legal direct taxes upon the rural lands, of whichever category, are two-fold; first, one-tenth of all produce grown, whether on the ground or trees; second, four per mille is levied annually on the estimated value of the land and farm buildings. Urban house property is taxed eight per mille on its estimated value per annum.

Mode of Cultivating the Land.—In a country so sparsely populated as this is, and where fertilising substances are only used for gardens, cotton and tobacco fields, it is not to be wondered at that every third year the land remains fallow. Thus, a field which is sown with a summer crop, such as Indian corn, millet, sesamy, beans, vetch, &c., is in the following autumn sown in with wheat, barley, or horse beans, &c., which are the winter crops; the third year the field is left fallow.

The agricultural implements in actual use, if not dating from the time of Homer, are certainly of the most primitive style. The following are the principal implements in use:—The plough (simply a triangular block of hard wood, with an iron cap on the point, one pole in front to yoke the oxen to it, and one behind to guide it), the harrow, rake, sickle, spade, pickaxe, shovel, pitchfork, seive, winnow, and a coarse two-wheeled bullock cart. The ploughing is done about three or four inches deep, while the distance between each furrow is 12 inches wide; with such a method of tillage, it is only a marvel that a ten-fold produce of barley and wheat, 20 to 25 of beans, 25 to 35 of millet and maize, is considered to be a good out-turn. Although there is hardly a drop of rain from May to October, still irrigation is not made use of for any other purposes than vegetable gardens, and occasionally for the maize fields.

The thrashing of cereals is performed by horses and bullocks, and that of beans, sesamy, millet, &c., by the frail or simple stick. After the thrashing is over, the straw is chopped up by a kind of harrow, fitted with sharp-edged disks, and stored away as fodder for the cattle.

The rural lands are divided into large farms (chiftlik), owned by the wealthy classes and in small peasant proprietorships. The large estates are generally worked as in the southern countries of Europe, by the peasantry on the half-profit system, the proprietor giving the land, seed, and half the expense of reaping if cereals, of harrowing and weeding if cotton, maize, or beans, &c. After deducting the fiscal share

of 10 per cent., and divers other common compensations paid in kind, such as village herdsmen, rural police, &c., the remainder of the produce is divided in two equal shares—the one for the proprietor, and the other for the peasant. In some parts of the country, where the population is sparse, a system of leasing the land for one year exists, but the peasants prefer the half-profit system, for the reason that they require no capital; moreover, whether the season be good or bad, they always manage to get their bread stuff stored away till the next harvest by contriving to steal some of the seed, or when the harvest is gathered in, also their wives and children have a legitimate resource in the shape of gleaning. Certainly not less than 8 per cent. of the cereal produce is left on the ground by the reapers.

Having, as I already pointed out, the advantage of such an extended sea coast, as well as the two lines of railway—Smyrna to Aïdin, and Smyrna to Alasheir—leading a fair distance in the interior, all this facilitates the transport of the produce for exportation; therefore, both peasant and proprietor are, comparatively speaking, in easy circumstances. True, the requirements of the rural population, as far as food is concerned, are not much; bread, vegetables prepared with oil, milk, pekmez (a syrup extracted from the black raisin), form their staple food. Meat and rice are only occasional luxuries with them. On the other hand, our rural population spend a good deal in dress. Unlike the peasants of European Turkey, whose clothings are made of native manufacture, here their cloth and linen are of foreign make, and, consequently, more expensive.

As a rule, the peasantry in this country do not plant any vegetables, therefore gardening forms a separate and very remunerative industry both in the cities and the rural districts. This may be inferred from the following instance. I know a gardener's family in this city, consisting of a man, wife, and child, who has a tenement of two acres of garden and orchard; he pays £10 rent, £2 10s. taxes annually, keeps two permanent servants, and occasionally employs additional hands; he also keeps two horses; and all manage to live decently upon the produce of that garden. Lastly, the peasantry have another resource of income in the breeding of cattle; the fodder, as aforesaid, consists of straw, and the pasturage costs them nothing; the only tax they have to pay on this head is for sheep, goats, and pigs—for the former two, 9d. each a-year, and for the latter, 1s. 10d.

In conclusion, the state of agriculture in Asia Minor generally must not be confounded with that of this propitiously situated province; otherwise so abundantly gifted by nature, the lot of the peasant, the farther removed in the interior, the more unfortunate it is, both on account of the want of roads, and the desert in which his repining voice is lost.

S. Stab.
Corresponding Member, Society of Arts.

Smyrna, 4th September, 1880.

THE LIBRARY.

The following works have been presented to the Library:—

Fac-similes of the Declaration of Independence and the Treaty of Waitangi (Wellington, 1877). Presented by Lord Alfred S. Churchill.

Designs and Catalogue of Cabinet and Upholstery, Furniture, Looking-glasses, &c., by C. and R. Light. Presented by the publishers (C. and R. Light, London, 1880).

A Physical Treatise on Electricity and Magnetism, by J. E. H. Gordon, B.A. Two vols. (London: Sampson, Low, and Co., 1880), presented by the Publishers.

Catalogue of Pictures, Drawings, and Art Objects lent to the Royal Commission for the Australian International Exhibitions. (London: 1880.) Presented by the Commissioners.

The Antiquities of Orissa, by Rájendralála Mitra, LL.D., C.I.E. Vol. 2. Published under orders of the Government of India. (Calcutta: W. Newman and Co., 1880.) Presented by the Govnrnment of India.

Science for All. Edited by Robert Brown, M.A., Ph.D. Vol. 3. (London: Cassell, Petter, Galpin, and Co., 1880.) Presented by the publishers.

Melbourne Universal Exhibition, 1880. France: Notices on the Designs, Models, and Works pertaining to the services of the Ponts et Chaussées, the Mines, and the Public Edifices and National Palaces, translated by David Coales. (Paris: National Press, 1880.) Presented by the French Government.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 15th...British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8.30 p.m.
Royal Asiatic, 22, Albemarle-street, W., 3 p.m.

Tuesday, Nov. 16th...Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Renewed Discussion on Mr. Walker's paper, "Machinery for Steel-making." 2. Mr. J. P. Maxwell, "New Zealand Government Railways." 3. Mr. J. R. Mosse, "Ceylon Government Railways."
Statistical, Somerset-house-terrace, Strand, W.C., 7.45 p.m. 1. Inaugural Address, by the President, Mr. James Caird. 2. Dr. F. J. Mouat, "Note on the Tenth Census of the United States of America."
Pathological, 53, Berners-street, Oxford-street, W., 8¼ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. The Secretary, "Report on the Additions made to the Society's Menagerie during the months of June, July, August, and September, 1880." 2. Mr. W. K. Parker, "The Structure and Development of the Skull of the Urodeles." 3. Mr. A. Boulenger, "The Palæarctic and Ethiopian Species of Bufo."
Royal Horticultural, South Kensington, S.W., 1 p.m.

Wednesday, Nov. 17th...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Opening Meeting of the Session. Address by Mr. F. J. Bramwell, Chairman of the Council.
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. Edward E. Dymond, "Table of Relative Humidity." 2. Mr. John G. Gamble, "Rainfall in South Africa." 3. Mr. Henry L. Roth, "The Meteorology of Mackay, Queensland." 4. Captain W. F. Caborne, "Thermometrical Observations on board Ship."
Geological, Burlington-house, W., 8 p.m. 1. Mr. Charles Moore, "Abnormal Geological Deposits in the Bristol District." 2. Mr. J. B. Kendal, "Interglacial Deposits of West Cumberland and North Lancashire."
Institute of Bankers (at the Theatre of the London Institution, Finsbury-circus, E.C.), Mr. John Dun, "The Law of Value."
Archæological Association, 32, Sackville-street, W., 8 p.m. 1. Mr. C. H. Compton, "The Martin Tower, Tower of London." 2. Mr. E. P. Loftus Brock, "Remains of a Roman Wall, Tower of London."

Thursday, Nov. 18th...Royal, Burlington-house, W., 4½ p.m. 1. Messrs. L. F. Nilson and Otto Pettersen, "The Essential Properties and Chemical Character of Beryllium." 2. Messrs. L. F. Nilson and Otto Pettersen, "The Molecular Heat and Volume of the Rare Earths, and their Sulphates." 3. Dr. W. J. Russell, "The Absorption Spectra of Cobalt Salts." 4. Prof. W. C. Unwin, "The Friction of Water against Solid Surfaces of Different Degrees of Roughness."
Linnean, Burlington-house, W., 8 p.m. 1. Dr. J. Dennis MacDonald, "Classification of Gasteropoda." 2. Rev. G. Henslow, "A Proliferous Condition of *Verbascum nigrum*." 3. Dr. G. Dobson, "*Metabdella McDonaldii*, the Type of a new Order of Vermes." Messrs. P. McOwan and Harry Bolus, "Novitates Capensis." 5. Rev. M. J. Berkeley, "Australian Fungi."
Chemical, Burlington-house, W., 8 p.m. 1. Mr. Spencer Pickering, "Notes on the Oxides of Manganese." 2. Dr. J. H. Gladstone and Mr. A. Tribe, "Aluminium Alcohols." Part I. "Their Preparation by Means of the Aluminium Iodine Reaction." 3. Mr. Edward Moritz, "The Synthetical Production of New Acids of the Pyruvic Series." Part II.
Royal Historical, 11, Chandos-street, W., 8 p.m.
Numismatic, 4, St. Martin's-place, W., 7 p.m.
Royal Society Club, Willis's-rooms, St. James's, S.W., 6 p.m.

Friday, Nov. 19th...Philological, University College, W.C., 8 p.m.

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg leave to acknowledge, with thanks to the Proprietors, the regular receipt of the following Transactions of Societies and Periodicals during the year:—

TRANSACTIONS, &c.

Aeronautical Society, Annual Report.
Amateur Mechanical Society, Journal.
American Chemical Society, Journal.
American Society of Civil Engineers, Transactions.
Art Union of London, Report.
Bayerische Dampfkessel-Revisions-Verein, Bayerisches Industrie-und-Gewerbeblatt.
British Association for the Advancement of Science, Report.
British Association of Gas Managers, Report of the Proceedings.
British Horological Institute, Journal.
Charity Organisation Society, Reporter.
Chemical Society, Journal.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institution, Journal.
Geological Society, Journal.
Geologists' Association, Proceedings.
Glasgow Philosophical Society, Proceedings.
Index Society, Publications.
India, Geological Survey of, Memoirs, Records, and Palæontologia Indica.
Indian Meteorological Memoirs.
Institute of Bankers, Journal.
Institution of Civil Engineers, Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Naval Architects, Transactions.
Iron and Steel Institute, Journal.
Lancashire and Cheshire, Historic Society of, Transactions.
Linnæan Society, Journal.
Liverpool Literary and Philosophical Society, Proceedings.
Manchester Field Naturalists' and Archæologists' Society, Report and Proceedings.
Manchester Literary and Philosophical Society, Memoirs.
Manchester Steam Users' Association, Monthly Report.
Meteorological Society, Quarterly Journal.
Milano. Reale Istituto Lombardo di Scienze e Lettere, Rendiconti
Musée de l'Industrie de Belgique, Bulletin.
National Association for the Promotion of Social Science, Sessional Proceedings.
National Indian Association, Journal.
National Life Boat Institution, Journal.
Pharmaceutical Society, Journal and Transactions.
Philadelphia Engineers, Club of, Proceedings.
Photographic Society, Journal.
Physical Society of London, Proceedings.
Quekett Microscopical Club, Journal.
Royal Agricultural Society, Journal.
Royal Asiatic Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Report.
Royal Geographical Society, Proceedings and Journal.
Royal Irish Academy, Transactions and Proceedings.
Royal Scottish Society of Arts, Transactions.
Royal Society, Proceedings and Philosophical Transactions.
Royal United Service Institution, Journal.
Schlesische Gesellschaft für vaterländische Cultur, Jahres Bericht.
Société d'Acclimatation, Bulletin Mensuel.
Société d'Encouragement pour l'Industrie Nationale, Bulletin.
Society of Antiquaries, Archæologia and Proceedings.
Society of Biblical Archæology, Transactions.
Society of Engineers, Transactions.
Society of Telegraph Engineers, Journal.
Statistical Society, Journal.
Victoria Inst., Journal.
Württemberg, Königliche Centralstelle für Gewerbe und Handel, Jahresberichte.
Zoological Society, Proceedings and Transactions.

PERIODICALS.

Weekly.

Agricultural Gazette.
American Architect and Building News.
American Gas Light Journal.
Architect.
Athenæum.
Bombay Gazette, Overland Summary.
British Architect and Northern Engineer.
British Journal of Photography.
British Mercantile Gazette.
Builder.
Building News.
Builders' Weekly Reporter.
Capital and Labour.
Ceylon Observer, and Weekly Summary of Intelligence.
Ceylon Times, Weekly Summary.
Chamber of Agriculture Journal and Farmers' Chronicle.
Chemical News.
Chemiker-Zeitung.
Colliery Guardian.
Colonies and India.
Design and Work.
Draper.
Electrician.
Electricité.
Empire.
Engineer.
Engineering.
Engineering and Building Times.
English Mechanic.
European Mail.
Examiner.
Farmer.
Furniture Gazette.
Gardeners' Chronicle.
Herapath's Railway Journal
House and Home.
India, Times of (overland weekly edition).
Ingénieur Universel.
Inventors' Record and Industrial Guardian.
Irish Builder.
Iron.
Iron Age.
Ironmonger.
Journal d'Hygiène.
Journal of Gas Lighting.
Land and Water.
Les Mondes.
Local Government Chronicle.
London and China Telegraph.
London Iron Trade Exchange.
Metropolitan.
Miller.
Mining Journal.
Moniteur des Arts.
Musical Standard.
Musical World.
Nature.
Nottinghamshire Guardian
Parisian.
Photographic News.
Produce Markets' Review.
Queen.
School Board Chronicle.
Schoolmaster.

Scientific American.
Staffordshire Sentinel.
Statist.
Temperance Record.
Warehousemen & Drapers' Trade Journal.
York House Papers.

Fortnightly.

Art Interchange.
Brewers' Guardian.
British and Colonial Printer and Stationer.
Corps Gras Industriels.
Gaceta Industrial.
Ingénieur Conseil.
Jeweller and Metal Worker.
Monde de la Science et de l'Industrie.
Moniteur de la Teinture.
Publishers' Circular.
Review of Gas and Water Engineering.

Monthly.

American Journal of Industry.
Analyst.
Annales du Génie Civil.
Artist.
Atlantic Monthly.
Bookseller.
British Trade Journal.
Building World.
Canadian Patent Office Record.
Caterer.
Chemist and Druggist.
Chronique Industrielle.
Crónica de la Industria.
Educational Times.
Foreman Engineer and Draughtsman.
Gas Engineer.
Journal of Applied Science.
Journal of Education.
Journal Telegraphique.
Leather Trades' Circular.
Lumière Electrique.
Machinery Market.
Magazine of Art.
Manufacturers' Review and Industrial Record
Mineral Water Trades' Review.
Monatsschrift für den Orient.
Moniteur Scientifique.
Nautical Magazine.
Paper Makers' Circular.
Pottery Gazette.
Provisioner.
Revue d'Hygiène et de Police Sanitaire.
Revue des Industries.
Revue Industrielle.
Revue Maritime et Coloniale.
Saddlers', Harness-makers', and Carriage Builders' Gazette.
Sanitary Engineer.
Sanitary Record.
Stationer.
Sugar Cane.
Symons's Meteorological Magazine.
Telegraphic Journal and Electrical Review.
Textile Manufacturer.
Watchmaker, Jeweller, and Silversmith's Trade Journal.
Wine Trade Review.
Workmen's Hall Messenger.
Zeitschrift für Baukunde.

Quarterly.

Journal of Mental Science.
Paper and Printing Trades' Journal.

DAILY NEWSPAPER.

Sheffield and Rotherham Independent.

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